Public Comment Draft

AN EVALUATION OF PCB TESTING CONDUCTED AT THE ALLENDALE ELEMENTARY SCHOOL PITTSFIELD, MA

Massachusetts Department of Public Health
Center for Environmental Health
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BACKGROUND

The purpose of this report is to provide a comprehensive evaluation of the results of the follow-up surface wipe, unit ventilator filter, carpet surface dust, vacuum bag dust, indoor air, testing/analysis for polychlorinated biphenyl compounds (PCBs) at the Allendale Elementary School in Pittsfield, Massachusetts (see Figure 1). In addition to indoor environmental sampling, PCB serum testing of students, parents, faculty and staff of the Allendale School was offered as a service to the Allendale School community in response to requests from some members of the Allendale School community for these tests.

The Massachusetts Department of Public Health, Center for Environmental Health, Environmental Toxicology Program (MDPH/CEH/ETP), in collaboration with the Pittsfield Board of Health, first conducted indoor environmental testing at the school in November and December 2005. At that time, all samples (a total of 88 samples of surface dust, indoor air, and unit ventilator filter, as well as two outdoor air samples) showed no detectable levels of PCBs. The samples were analyzed using U.S. Environmental Protection Agency (USEPA) methods, which measure Aroclors. Aroclor is the industrial trade name for commercially produced mixtures of PCBs. Subsequent to this effort, MDPH/CEH and other local and state agencies involved with the GE Site learned of two filter samples reportedly taken from the school by a community resident and analyzed by the State University of New York at Albany (SUNY). SUNY used a different analytical technique (congener-specific) than the MDPH contract laboratory and reported the presence of low level PCBs in the samples. Congeners are single, unique compounds within PCBs (ATSDR 2000). In order to best address continuing concerns, MDPH/CEH agreed to conduct additional sampling at the school in collaboration with all involved parties.

INTRODUCTION

MDPH/CEH formed an indoor environmental testing work group comprising members of the: Housatonic River Initiative (HRI); Allendale School Task Force; SUNY; Spectrum

Analytical, Inc. (SAI); Southwest Research Institute (SWRI); Allendale Elementary School; Massachusetts Department of Environmental Protection's Bureau of Waste Site Cleanup (MDEP); Pittsfield Board of Health; and MDPH/CEH Environmental Toxicology Program. USEPA provided technical assistance.

The workgroup developed a detailed protocol that included descriptions and rationale behind the types of samples to be collected, their location, collection and analysis methods, chain of custody, quality assurance/quality control (QA/QC), and data evaluation. Three formal meetings and several conference calls amongst various workgroup members were held between January and May 2006. The draft protocol was released by MDPH/CEH in May 2006 for public comment. MDPH/CEH received eight sets of comments, which were reviewed and discussed among several working group members prior to the commencement of sampling. A formal response to these comments is attached to this report.

Concurrent with protocol development for indoor environmental testing, MDPH/CEH also requested analytic laboratory assistance from the U.S. Centers for Disease Control and Prevention (CDC) and the MDPH State Laboratory Institute in developing a protocol for conducting serum PCB testing offered to the Allendale School community. Through the winter and early spring of 2006, MDPH/CEH staff developed or compiled the following materials:

- A summary of the PCB serum testing protocol that included a description of topics to be included in the questionnaire and a proposed interpretation of the results;
- The Consent Form for both an adult participant and a parent on behalf of their child participant;
- CDC's blood sample collection and handling protocol;
- CDC's analytic method for analyzing PCBs in serum;
- CDC's PCB sections of the Third National Report on Human Exposure to Environmental Chemicals (2005)

In April 2006 MDPH/CEH formed a Health and Medical Peer Review Team (HMPRT) comprised of environmental health physicians/experts to review and comment on these materials. The HMPRT was also provided with selected articles in the most current literature on PCBs. MDPH/CEH received comments from the HMPRT, which were reviewed and incorporated into the project summary and consent documents. A formal response to these comments can be found as part of Appendix B.

INDOOR ENVIRONMENTAL TESTING

METHODS

Sample Collection

Sample collection began on Monday, June 12, 2006, the last week of the school year. The nearby General Electric disposal site was operational and receiving waste, thereby reflecting conditions to maximize the ability to detect PCBs that might be present. Additionally, the weather was favorable for maximizing the potential for PCB volatilization from the GE disposal area (i.e., increasingly warmer, dry, and windy weather proceeded by a period of rain). The weather station at Pittsfield Municipal Airport reported daily showers from the previous Wednesday, June 7th to Saturday, June 10th, with high temperatures ranging from 57° to 64° F and daily rainfall ranging from a trace to 0.4 inches. The weather began clearing on Sunday, June 11th, and continued into Monday, June 12th, with partly sunny conditions, the temperature reaching 73° F, and average wind speed of 7 miles per hour (mph) out of the west-northwest, which is the direction from the disposal site towards the school (see Figure 1) (www.wundergound.com 2006).

On Monday, June 12th, Environmental Compliance Services, Inc. (ECS) collected the surface wipe, unit ventilator filter and carpet dust samples. Accompanying the ECS staff were Elaine Krueger, Director of the CEH/ETP, Michael Celona, Senior Environmental Analyst in the CEH/ETP, and Mr. Geoff Coelho, the Allendale Elementary School

science teacher. Dr. Phil Adamo, Chairman of the Pittsfield Board of Health, was also present for a portion of the sampling. Samples were collected according to the protocol, with one exception. The surface wipe sample from the gymnasium was originally to be collected from above a hanging ceiling light. To obtain this sample it was planned to use a hydraulic lift. However, due to an inability to get the lift to operate, the surface wipe sample was collected using a ladder from a windowsill approximately 10 feet from the gymnasium floor. As discussed in the protocol, six additional surface wipe samples were to be collected from locations chosen by Mr. Coelho during the sampling round. The six locations were the following: the ceiling vent in the Health Office; inside classroom #24's unit ventilator in an area where air pools before being filtered; the ceiling fan blade in classroom #27; the storage bin cover in classroom #24; the ceiling pipe in classroom #23; and the top of a VCR in classroom #28. All of these locations contained visible dust and were inaccessible to the students. Most of the locations were also inaccessible to staff without the use of a ladder. See Table 1 for a list of the sample locations and Figure 2 for the school floor plan.

The collection of the air samples and vacuum bag dust samples also began on June 12th. The air samples were collected over two 24-hour periods (i.e., Monday-Tuesday and Tuesday-Wednesday). Although the Protocol discusses only one vacuum cleaner, the school uses two vacuum cleaners to vacuum the school. Therefore, two vacuum bag samples were collected on Friday, June 16th, after the vacuum cleaners were used to vacuum the entire school during the week. Chain of custody on the vacuum cleaners was maintained throughout the week by ECS staff.

Due to damage to the air and unit ventilator filter sample containers during shipping, the unit ventilator filter samples and the air samples were subsequently re-collected. The unit ventilator filters were re-sampled from the same two classrooms (#21 and #24) on Wednesday, June 14th. The air samples were collected over two 24-hour periods beginning on Thursday, June 22 (i.e., Thursday-Friday and Friday-Saturday). On Thursday, June 22nd, the nearby General Electric disposal site was operational and receiving waste. According to the weather station at Pittsfield Municipal Airport, the

weather on Monday, June 19 and Tuesday June 20 consisted of temperatures of 86° F and 77° F and rainfall of 0.45 and 0.52 inches, respectively. The weather cleared on Wednesday, June 21, with a temperature of 75° F and an average wind speed of 5 mph out of the west-southwest direction. The weather on Thursday, June 22nd and Friday, 23rd consisted of temperatures of 81° F both days, very small amounts of precipitation (0.02 and 0.07 inches, respectively) and an average wind speed of zero mph (highest wind speeds of 8 mph and 9 mph, respectively, out of the southwest-west). On Saturday, June 24th, the temperature was 73° F, approximately 0.4 inches of rain fell, and the average wind speed was 1 mph out of the west-northwest (www.wundergound.com 2006).

Because three different laboratories were analyzing samples, some additional sample preparation or collection was required prior to the laboratories beginning their analysis. By medium, these additional steps are briefly described below:

- Wipes: For each wipe sample location, three co-located wipe samples were taken with each sample sent to a different laboratory. The three co-located samples were taken side-by-side (but not over the previously wiped area) at the designated sample location.
- Air: All air samples were sent to SWRI for extraction into a solution and then split such that each of the three laboratories had a portion of the extracted solution.
- Unit ventilator filters: Three clippings (from edges) from each filter sampled were collected, with one clipping sent to each of the laboratories.
- Carpet dust: Three samples from separate 25 square foot sections of the carpet were collected. Each lab received one of the three samples.
- Vacuum bag dust: Samples were sent to SWRI for extraction and then split into samples for each laboratory to analyze.

Sample Analysis

Prior to the three laboratories (SAI, SWRI, and SUNY) processing the samples, their analytical methods and quality assurance/quality control procedures (standard operating procedures or SOPs) were reviewed by the USEPA Office of Environmental Measurement and Evaluation, Quality Assurance Unit in Chelmsford, MA. The Unit provided comments on the laboratory's methods and procedures. SAI analyzed samples for Aroclors, SUNY for congeners and SWRI for both Aroclors and congeners. SAI analyzed samples for Aroclors using USEPA Method TO-4A (air, vacuum bag dust) and USEPA Method SW846;8082 (carpet dust, wipes, vent filters). SWRI analyzed samples for Aroclors and congeners using modified USEPA Method TO-4A, and SUNY analyzed for congeners using a method based on two research papers published by SUNY (DeCaprio et al. 2000, 2005). The Aroclor analyses targeted seven Aroclors, while the congener analyses targeted 101 congeners (see details in protocol contained in Appendix A). As part of the QA/QC protocol developed prior to the start of sampling, SWRI and SUNY agreed to analyze a sample from the National Institute of Standards and Technology (NIST) that contained known quantities of certain congeners. The purpose of this step was to determine the comparability of the SWRI and SUNY analyses and how closely their results matched with the known quantities of congeners in the NIST sample. Results of these analyses are contained in Appendix D.

Methods for Initial Screening of Results

Health assessors use a variety of health-based screening values, called comparison values, to help decide whether compounds detected in environmental samples might need further evaluation. These comparison values include cancer risk evaluation guides (CREGs) and environmental media evaluation guides (EMEGs), which are values that have been scientifically peer reviewed or derived using scientifically peer-reviewed values and published by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). CREG values provide information on the potential for carcinogenic effects, while EMEG values are used to evaluate the potential for noncancer health effects. Chronic EMEGs correspond to exposures lasting one year or longer in a residential

setting. CREG values are derived assuming a lifetime of daily exposure (i.e., 70 years) in a residential setting.

If the concentration of a compound exceeds its comparison value, adverse health effects are not necessarily expected. Rather, these comparison values help in selecting compounds for further consideration. For example, if the concentration of a chemical in a medium (e.g., air) is greater than the CREG for that medium, the potential for exposure to the compound should be further evaluated for the specific situation to determine whether cancer health effects might be possible. Conversely, if the concentration is less than the CREG, it is unlikely that exposure would result in cancer health effects.

For surface wipe samples, ATSDR has no comparison values but the USEPA has a regulatory clean-up standard of 10 micrograms PCB per 100 square centimeters (10 µg /100 cm^2) for wipes collected from indoor residential surfaces that have been affected by a spill of a low-concentration PCB mixture (40 Code of Federal Regulations 761.125). In addition, the California Department of Toxic Substance Control has published a recommended clean-up guideline for PCBs on surface areas in schools of 0.1 µg/100 cm^2. This recommended standard for California is intended to be protective of short and long term exposures involving dermal contact and incidental ingestion (CDTSC 2003).

Results for dust samples from carpet and the vacuum cleaners were compared to ATSDR comparison values or regulatory standards for residential soils. The ATSDR comparison values for PCBs in residential soils are 1 milligram per kilogram (mg/kg) (chronic EMEG for children), 10 mg/kg (chronic EMEG for adults), and 0.4 mg/kg (CREG) (the International Agency for Research on Cancer has classified PCBs as "probable human carcinogens" based on sufficient evidence of carcinogenicity in animals and limited evidence in humans) (ATSDR 2000). The MDEP residential soil standard under the Massachusetts Contingency Plan (MCP) is 2 mg/kg. For air samples, results were compared with the ATSDR comparison value of 0.01 microgram per cubic meter of air (µg/m3) (CREG).

There are no available comparison values for PCBs in vent filter samples. These results were qualitatively evaluated by reviewing information on other sample results from the same rooms.

If any sample had at least one detectable Aroclor or congener and other Aroclors or congeners that were not detected in the sample, the total PCB concentration of the sample was calculated in two ways. The first way was to assume all non-detected Aroclors or congeners in the samples to be present in the sample at a concentration of one-half the detection limit (see Table 2 for detection limits). The second method was to assume all non-detectable Aroclors or congeners not to be present (this method is how SUNY reported their data).

RESULTS

Surface Wipe Samples

For the Aroclor analysis, SAI did not detect any PCBs in any of 27 surface wipe samples, while SWRI reported a detection in one of 27 samples [Three co-located samples were taken from 27 locations – hence, a total of 81 wipe samples were taken.] The one sample with a detection was of Aroclor 1260 at a concentration of 0.294 µg/100 cm^2 (assuming non-detected Aroclor at ½ the detection limit), well below the USEPA cleanup standard, and slightly above the California cleanup guideline (Tables 3 and 4). This sample was from a windowsill and was mentioned earlier in this report. The windowsill had a large amount of dust on it, was located about 10 feet from the floor in the gymnasium, and was inaccessible without a ladder. If we assumed all non-detected Aroclors in this sample as zero, the total PCB concentration would be 0.144 µg/100 cm^2, which again was below the USEPA cleanup standard (10 µg/100 cm^2) and slightly above the California cleanup guideline (0.1 µg/100 cm^2) (Table 4).

Using the congener method, two of the 27 samples analyzed by SWRI showed the presence of PCBs. The sample from the same location on the gymnasium windowsill

discussed above had a PCB concentration of 0.280 µg/100 cm^2 in a surface wipe sample (SWRI), assuming all non-detected congeners were present at one-half the detection limit (Tables 3 and 4). Again, this was well below the EPA cleanup standard and slightly above the California cleanup guideline. One other surface wipe sample taken from a vent in the ceiling of the health office had a PCB concentration (congener method; SWRI) of 0.259 µg/100 cm^2, again assuming all non-detected congeners were present at one-half the detection limit. SUNY reported a concentration of 0.0218 µg/100cm^2 in a wipe sample from this location, well below both EPA and California cleanup levels. If we assume that the congeners that were not detected in these samples were at zero, then the SWRI concentrations in the gymnasium and ceiling vent samples were 0.070 and 0.006 µg/100 cm^2, respectively, which are again below both cleanup levels. The nurse reported that the ceiling vent had not been cleaned for a considerable period of time and was visibly dusty and dirty (see picture). As mentioned SWRI did not detect PCB congeners in any of the other wipe samples from throughout the school.

It should be noted that the SWRI samples of the gymnasium windowsill and health office ceiling vent had between 75 and 100 percent of the detected congeners flagged with a "J". A "J" flag is a quality assurance/quality control designation that indicates that the constituent is present in the sample but the concentration lies somewhere below the method detection limit but above the lower calibration limit.

SUNY, which reported a detection limit more than 10 times lower than SWRI for congener analyses of wipe samples (0.00028 vs. 0.005 µg/100 cm^2, respectively), reported a maximum total congener concentration in any wipe sample of 0.0467 µg/100 cm^2, below both the California and USEPA cleanup levels.

Air Samples

Air samples were collected in two indoor locations and one outdoor location for comparison, with samples collected on two different days for a total of six samples. Using the Aroclor methods, no indoor or outdoor air sample exceeded the ATSDR

comparison value (0.01 µg/m^3) (maximum concentration of 0.00333 µg/m^3; 0.00166 µg/m^3 if non-detected Aroclors are assumed to be zero) (Tables 3 and 4).

Since December 2005, the USEPA has been conducting routine ambient (outdoor) air monitoring at two locations on the Allendale School property, as well as at a location on the perimeter of the Hill 78 site located closest to the school (the "northwest" location; see Figure 3). PCBs are analyzed using the Aroclor method. Results from USEPA testing conducted at the time of the MDPH sampling effort in June 2006 revealed a concentration of 0.0071 µg/m^3 (Hill 78 perimeter) and 0.0037 µg/m^3 at each of the two Allendale School property locations (samples collected on June 22-23, 2006). These results were higher than those measured in the MDPH sample in the school and importantly were below the ATSDR comparison value. These results were flagged with a "J" value and reflect the sum of only detected Aroclors. USEPA treats non-detected Aroclors as zero when summing the concentrations.

Using the congener method, SUNY reported that one of two samples taken from classroom number 28 and one outdoor air sample taken for comparison had concentrations at approximately the ATSDR comparison value of 0.01 µg/m3 (0.0114 µg/m^3 and 0.0117 µg/m^3, respectively) (Tables 3 and 4). If we assume non-detects are zero and report what SUNY reported for these two samples, the concentrations remained similar (0.0112 µg/m^3 and 0.0116 µg/m^3). For both of these samples, SWRI reported concentrations at least ten times lower than the SUNY results using the congener method (0.001 and 0.0007 µg/m^3 for indoor and outdoor air, respectively). The SWRI air concentrations were thus below the ATSDR comparison value.

It is important to note that SUNY also reported detections of PCB congeners for all of the air blank samples that were part of the QA/QC protocol. Thus the PCB concentrations reported by SUNY may be overestimates of what was actually in the indoor or outdoor air. Units reported for blank detections are not the same as for the air samples because the blank analyses do not have associated air volumes. For four blank samples, SUNY reported a range of 0.610 to 1.885 µg/mL PCB congeners, assuming all non-detected

congeners were present at one-half the detection limit. Two of these blanks were field blanks. A field blank essentially involves sample collection equipment going through all the sampling and shipping procedures as the same equipment being used to collect the environmental sample (in this case, air samples) except that for the blank sampling equipment, no environmental samples are taken. Thus, a field blank is designed to determine whether improper handling of sampling equipment in the field or during shipment may result in contamination that may not originate from the environmental media being sampled. The other two blanks were new cartridges sent directly from the ECS office in Westfield and were not handled until they were received and processed by SWRI. Since SUNY found PCB congeners in all four blanks, not just those collected at the school, the sampling cartridges themselves may contain PCB congeners as an unintended background contaminant.

Dust Samples

Three carpet dust samples were collected from the school with one sample going to each of the three labs, and dust samples from two separate vacuum bags were also collected and analyzed for PCBs. Any detections using either Aroclor or congener methods for dust were below ATSDR comparison values (Tables 3 and 4). Using the Aroclor method, SWRI reported no detectable PCBs in the carpet dust sample, while SAI reported one Aroclor (Aroclor 1260) at a concentration of 0.0592 mg/kg. If we assume the non-detected Aroclors were present at one-half the detection limit, then the concentration would be 0.238 mg/kg or less than the ATSDR comparison value of 0.4 mg/kg for residential soil. Using the congener method, SUNY detected a total of 0.111 mg/kg PCBs, while SWRI detected a total of 0.526 mg/kg (assuming non-detects at half the detection limit). If the non-detected congeners were assumed to be zero, the concentrations of PCB congeners were 0.0762 mg/kg (SWRI) and 0.107 mg/kg (SUNY), both below the ATSDR comparison value (Tables 3 and 4). SWRI flagged nearly all of its congener detects with a “J” flag, meaning the detections were estimates somewhere below the method detection limit.

For the vacuum bag samples and Aroclor method, SWRI did not detect PCBs (detection limit of about 0.1 mg/kg), while SAI reported detections of one Aroclor (i.e., Aroclor 1260) at 0.285 and 0.292 mg/kg, both below the ATSDR comparison value of 0.4 mg/kg. If we assume non-detected Aroclor (detection limit of 0.250 mg/kg for each Aroclor) was ½ the detection limit, then the total PCB concentrations for the vacuum bag samples were 1.28 and 1.29 mg/kg, above the ATSDR comparison value but less than the MDEP residential soil standard of 2 mg/kg.

For the congener analysis, SWRI detected 0.502 mg/kg and 0.534 mg/kg in vacuum bag dust samples (assuming half of the detection limit for all non-detected congeners), while SUNY reported a maximum of 0.0709 mg/kg in these samples. If we assume non-detects are zero, all samples analyzed by the congener method were well below the ATSDR comparison value of 0.4 mg/kg PCBs (0.0601 and 0.0687 mg/kg for SWRI) (Tables 3 and 4).

As with the carpet dust sample, SWRI flagged nearly all of its congener detections in vacuum bag dust samples with a "J" flag indicating uncertainty in the actual concentrations that lie somewhere below the method detection limit and the lower calibration limit.

Unit Ventilator Filter Samples

Using the Aroclor method, SAI did not detect PCBs in the two unit ventilator samples. SWRI detected 0.224 and 0.255 µg PCBs per sample (Aroclor method) assuming Aroclors not detected are present at one-half the detection limit. If we assume non-detects are zero, the results are 0.0743 and 0.105 µg PCBs per sample (Tables 3 and 4).

Similarly, using the congener method, both SUNY and SWRI reported the presence of PCBs, with SUNY reporting 0.0524 and 0.0800 µg PCBs per sample, while SWRI reported 0.260 and 0.268 µg/sample, similar to their Aroclor analyses. These results assume congeners are present at one-half the detection limit. If we assume non-detects

are zero, the results are 0.0468 and 0.0752 µg PCBs per sample for SUNY and 0.0298 and 0.0907 µg PCBs per sample for SWRI (Tables 3 and 4). About 75 percent of the detected congeners were reported by SWRI with a "J" flag.

As previously stated, there are no available guidance levels for PCBs in filter samples. Other types of samples taken in these classrooms and the results of these samples are as follows:

- Air: Two indoor air samples (taken on different days) were taken in Classroom 21. The maximum concentration reported by any lab for any method was 0.007 ug/m3, or below ATSDR comparison value of 0.01 ug/m3.
- Surface wipes: Four wipe samples were taken from Classroom 24. SAI and SWRI reported non-detect for all of these samples, using either the Aroclor (SAI and SWRI) or congener method (SWRI). SUNY reported using the congener method that three of four surface wipes from this classroom had detections, with a maximum concentration of 0.0139 ug/100cm2, well below both the California and USEPA cleanup levels (0.1 and 10 ug/m100 cm2, respectively).

Thus, no samples in these classrooms exceeded any available screening or cleanup levels. As an additional evaluation of the filter results from this room, we calculated an estimate of PCBs in the filter sample per kg filter weight to provide some level of comparison to the ATSDR comparison value for soil (given as mg PCBs per kg soil weight). Although neither SUNY nor SWRI reported the filter weights for the filter sample, it is reasonable to assume their filter samples were similar to those recorded by SAI which reported filter sample weights of 2 grams. The SWRI results are estimated to range from 0.112 to 0.128 mg PCBs/ kg filter and from 0.130 to 0.138 mg PCBs/ kg filter (Aroclor and congener methods, respectively). The SUNY analyses are estimated to be 0.0262 and 0.0400 mg PCBs/ kg filter. If we assume zero for the non-detected Aroclors or congeners, the maximum estimated concentration from the filters using either method is 0.0525 mg/kg. All of these concentrations are lower than the ATSDR comparison value of 0.4 mg/kg.

SUNY reported detections in the unit ventilator filter blank sample. The other two laboratories did not report detections in the filter blank sample.

DISCUSSION

Results of indoor environmental testing at the Allendale School revealed that most samples (93 of 98) taken did not exceed or were similar to any available health-based comparison values or surface cleanup standards or guidance used to initially screen the results (assuming non-detected Aroclor or congener were ½ detection limit). If all non-detected congener or Aroclors were assumed to be zero, then all but one sample were below or similar to any available comparison value or cleanup guidance. The one exception was a wipe sample from the gymnasium windowsill, where the concentration slightly exceeded the California cleanup guidance (0.144 µg/wipe vs. 0.1 µg/wipe CA Guideline). The following sections further evaluate the data and compare results with available information from the scientific literature.

Surface Wipe Samples

No PCBs were detected (using the Aroclor method) in any wipe sample analyzed by SAI. One wipe sample analyzed by SWRI for Aroclors detected the presence of PCBs that weas below the USEPA cleanup standard for surfaces or slightly above the California cleanup guidance. None of the other 26 wipe samples analyzed from throughout the school by SWRI using the Aroclor method showed detectable PCBs. Results analyzed using the congener method assuming that all non-detects were present at one-half the detection limit revealed a similar concentration in the gym windowsill sample, as well as a similar concentration in a ceiling vent sample taken in the health office. However, when determining total congener concentrations assuming non-detected congeners were zero, the total congener concentrations were well below available cleanup standards or guidance.

The wipe samples taken from the gymnasium windowsill and ceiling vent had visible dust layers. Given the inaccessibility of these areas to students and staff and that the results of all other surface wipe samples throughout the school were either non-detect or below available guidelines or standards, it is not expected that opportunities for exposures to PCBs in surface wipe samples from the school would result in any health concerns. Using the most conservative exposure scenario available, i.e., if the maximum concentration detected in a wipe sample was readily accessible on surfaces throughout the school on a daily basis for six years for children or 30 years for adults, opportunities for exposures to PCBs would not be expected to result in health concerns (see Appendix E for calculations).

It is important to note that surface wipe samples are generally taken to help determine where more aggressive cleaning may be necessary, not to assess health risks, as no comparison values are available. The EPA and California cleanup levels cited here are useful to help determine the need for more aggressive cleaning in the school. While most results of wipe samples were non-detect, certain areas (e.g., the windowsills and other areas not cleaned on a routine basis) should be inspected and cleaned with greater frequency.

Air Samples

No indoor or comparison outdoor air sample collected at the school and analyzed using the Aroclor method exceeded the ATSDR comparison value. Low levels of PCBs were detected in the samples, but given that PCB concentrations in air tend to be higher in warmer months than in colder months, which was an important reason to target this particular time of year for this sampling effort, these results are not remarkable. Using the congener method, SUNY reported a concentration in one indoor air sample and one comparison outdoor sample similar to the ATSDR comparison value (0.01 $\mu g/m^3$). However, SUNY also reported PCB detections in QA/QC blank samples for air and hence air results may be overestimated given detections in blank samples. SWRI reported congener-specific results about 10 times lower than the SUNY results (and

hence, less than screening values). In addition, SWRI qualified about half of the detected congeners as "J" flags, or estimated values somewhere below the method detection limit.

As previously discussed, ambient (i.e., outdoor) air samples taken by the USEPA at the same time period (June 22-23) as the MDPH samples from two locations on the Allendale School property revealed higher PCB concentrations (Aroclor method) than the MDPH outdoor air samples.

As mentioned earlier, PCB concentrations in air are generally higher in the summer months than in the winter months (ATSDR 2000). This has been observed in numerous other sampling events in Pittsfield. As part of the GE site evaluation and clean-up and in order to establish outdoor background concentrations of PCBs in the Pittsfield area, USEPA set up an ambient air monitoring station at Berkshire Community College (BCC), which is located approximately five miles west of the GE sites and the Allendale Elementary School. Sampling was conducted at BCC during several months in 1991, 1992, 1993, 1995, and 1996. Overall, 48 samples were collected and analyzed for PCB Aroclors. Fifteen of the 27 results taken in warmer months (i.e., mid-May to mid-September) showed PCB detections, with a mean concentration of 0.001 $\mu g/m^3$. Four of 21 results taken in cooler months showed PCB detections, with a mean concentration of 0.0004 $\mu g/m^3$ (MDPH 2003). The SAI and SWRI results for air samples were consistent with the BCC background levels for warmer months.

More recently, USEPA has been collecting air samples at two locations outside the Allendale School and analyzing them for PCB Aroclors. From December 6, 2005, to August 30, 2006, USEPA has collected 102 samples. Fifty-four of the 68 samples (or approximately 80%) taken from May 16-September 29 showed PCB detections, with a mean concentration equivalent to the samples at BCC {0.0016 $\mu g/m^3$ (range of detections from 0.0003 to 0.0059 $\mu g/m^3$)}. Nine of the 34 samples (or 26%) taken between December 6, 2005 and May 12, 2006 showed PCB detections, with a mean concentration of 0.00046 $\mu g/m^3$ (range of detections from 0.00015 to 0.0009 ug/m3).

To better interpret indoor air results, MDPH also evaluated available information regarding studies that have measured PCBs in indoor air. A recent evaluation of indoor air concentrations of PCBs at the New Bedford High School was conducted in April 2006 (Beta 2006). Six indoor air and two outdoor background samples were taken and analyzed for over 200 congeners. To compare with results from Allendale, we calculated the concentrations in the New Bedford data of the congeners that were analyzed at the Allendale Elementary School[1]. These concentrations ranged from 0.000098 to 0.051 ug/m^3, with an average of 0.020 ug/m^3 (Beta 2006). The two outdoor background samples for New Bedford were 0.00087 and 0.0010 ug/m^3. The source of the PCBs was hypothesized to be building materials in the school. These results are 30-50 fold higher than observed in Allendale samples based on SWRI congener specific methods.

In the MMR school mentioned previously, in addition to wipe samples, indoor air samples were also collected (EH8E 1995a; 1995b). The average of six samples taken in three rooms in the school in September 1995 revealed an average of 1.44 ug/m3, with a range of 1.02-2.87 ug/m3. As noted previously, the likely source of PCBs at the school was determined to be the presence of building materials containing PCBs.

A study was conducted comparing PCB congener concentrations in air from houses near New Bedford Harbor and houses located a distance from the Harbor in southeastern Massachusetts. Portions of the New Bedford Harbor were classified as a National Priority List site in 1983 due to PCB contamination. The New Bedford area study found indoor air concentrations in houses located near New Bedford Harbor ranging from 0.0079 µg/m^3 to 0.061 µg/m^3, with a geometric mean of 0.018 µg/m^3. Houses located a distance from New Bedford Harbor had concentrations ranging from 0.0052 µg/m^3 to 0.051 µg/m^3, with a geometric mean of 0.0052 µg/m^3 (Vorhees et al 1997). These concentrations were again higher than those detected in indoor air samples from the Allendale School, demonstrating the ubiquitousness of PCBs in the environment in general.

[1] Note that since SWRI analyzed for more congeners than SUNY, the congeners selected from the New Bedford High School data are those analyzed for by SWRI. Summing the congeners that SUNY analyzed for produces very slightly lower concentrations.

A study conducted in North Carolina, whose purpose was to establish background indoor concentrations of contaminants, such as PCBs, found concentrations of PCBs in one group of child care centers ranging from 0.0571 to 0.246 $\mu g/m^3$with an arithmetic mean of 0.0704 $\mu g/m^3$ and in another group of child care centers ranging from 0.00872 $\mu g/m^3$ to 0.258 $\mu g/m^3$ with an arithmetic mean of 0.0604 $\mu g/m^3$ (Wilson et al. 2001, Wilson 2006). Another study that analyzed indoor air in several office buildings, laboratories, and houses in a part of the United Kingdom for PCB congeners found concentrations ranging from 0.0011 $\mu g/m^3$ to 0.069 $\mu g/m^3$, with a mean concentration of 0.009 $\mu g/m^3$ (Currado and Harrad 1998). The indoor air samples at the Allendale School were within or less than the concentrations reported in the North Carolina and Great Britain studies.

A study conducted under contract to MDPH examined contaminants, including three PCB congeners (#52, 105, and 153) in indoor air and dust in 120 Cape Cod houses found detectable concentrations of at least one of the three congeners in indoor air from 38 of the houses. In all cases these results exceeded indoor air congener results for the Allendale School For example, congener #52 was detected in 37 of the Cape Cod houses at concentrations ranging from 0.000686 $\mu g/m^3$ to 0.0247 $\mu g/m^3$, with a mean concentration of 0.00414 $\mu g/m^3$. SUNY reported that congener #52 was detected in the four indoor air samples at concentrations ranging from 0.000213 $\mu g/m^3$ to 0.000356 $\mu g/m^3$, with a mean concentration of 0.000285 $\mu g/m^3$. SWRI reported that congeners #52+69 (SWRI reported both congeners at a combined concentration) were detected in the four indoor air samples at concentrations ranging from 0.0000500 $\mu g/m^3$ to 0.0000730 $\mu g/m^3$, with a mean concentration of 0.0000595 $\mu g/m^3$. The maximum detected congener values from inside the Allendale School do not exceed the minimum concentrations detected in the houses on Cape Cod.

Carpet and Vacuum Bag Dust

Results from carpet and vacuum bag dust samples revealed some samples using either the Aroclor or congener method and assuming non-detection at ½ the detection limit that

exceeded the ATSDR comparison value of 0.4 mg/kg but all samples were less than the regulatory residential soil standard of 2 mg/kg. If we assume non-detected Aroclors or congeners are zero, neither carpet nor vacuum bag dust samples exceeded the ATSDR comparison value or the regulatory soil standard using either analytic techniques.

If we assume a maximum concentration of 0.526 mg/kg (based on calculating all non-detects at one-half the detection limit), daily exposure to children for 6 years or to adults for 30 years, opportunities for exposures to PCBs would not be expected to result in health concerns (see Appendix E for calculations).

MDPH also evaluated the scientific literature for information on indoor dust measurements in other studies. Two studies from New Bedford and North Carolina analyzed PCB concentrations in carpets. The New Bedford study found a geometric mean concentration of 1.4 mg/kg in houses near the Harbor and 0.69 mg/kg in houses located a distance from the Harbor (Vorhees et al. 1999). Another study, analyzing dust on the classroom floors of several child care centers in North Carolina for various compounds, including 20 PCB congeners, found levels of PCBs in one group of four child care centers ranging from 0.143 to 2.76 mg/kg with an arithmetic mean of 1.05 mg/kg and in another group of seven child care centers ranging from 0.072 to 28.2 mg/kg with an arithmetic mean of 7.69 mg/kg (Wilson et al. 2001). The location and/or possible effect of nearby contaminated sites are not mentioned in the study. By comparison, the results of carpet sampling at Allendale Elementary School showed maximum PCB concentrations in carpet of 0.526 mg/kg (assuming no detection = ½ detection limit), which was lower than the geometric mean concentration found in New Bedford Harbor homes located farthest from the source of PCB contamination in the harbor.

In the North Carolina study mentioned above, the contents of the vacuum cleaner from one group of three child care centers and a second group of four child care centers were analyzed for 20 PCB congeners. These vacuum cleaners were owned and operated by the child care centers and were operated for one month before the vacuum bag was removed and its contents analyzed. The concentration in the vacuum bag from the first group of

child care centers ranged from 0.139 to 1.99 mg/kg with a mean of 0.785 mg/kg and from the second group of child care centers ranged from 0.120 to 3.15 mg/kg with a mean of 2.45 mg/kg (Wilson et al. 2001). By comparison, the results of vacuum bag sampling at Allendale Elementary School, which were analyzed for 101 congeners, showed maximum PCB congener concentrations of 0.534 mg/kg. The maximum PCB Aroclor concentration was 1.29 mg/kg (assuming non-detects = ½ detection limit), or 0.292 mg/kg (assuming non-detects = zero). These concentrations are within the range found in the North Carolina study.

The MDPH-sponsored study on Cape Cod found detectable concentrations of at least one of the PCB congeners (#52, 105, and 153) in indoor dust from 22 of the 120 houses included in the study. The dust was collected by vacuuming the surfaces of rugs, floors, upholstery, furniture, ceiling fans, and windowsills (Rudel et al. 2003). Similar to the air results, the maximum detected congener values from inside the Allendale School do not exceed the minimum concentrations detected in the Cape Cod houses. For example, congener #153 was detected in 19 of the Cape Cod houses at concentrations ranging from 0.0754 mg/kg to 35.3 mg/kg, with a mean concentration of 4.74 mg/kg. SUNY reported that congener #153 was detected in the carpet dust sample at a concentration of 0.00341 mg/kg and in the vacuum bag samples at concentrations of 0.00258 mg/kg and 0.00297 mg/kg. SWRI reported that congener #153 was detected in the carpet dust sample at a concentration of 0.0073 mg/kg and in the vacuum bag samples at concentrations of 0.0086 mg/kg and 0.01 mg/kg. All of these concentrations are lower than the detected concentrations in the Cape Cod homes.

Unit Ventilator Filters

SAI did not detect PCBs in the unit ventilator samples (Aroclor method). SUNY and SWRI detected low concentrations of PCBs in the filter samples. Other media sampled in these rooms (air, surface wipes) were below any available guidelines or cleanup levels. When converting the amount of PCBs detected in the vent filter samples, the estimated concentrations in mg/kg were less than guidelines for mg/kg in soil. Thus, the filters did

not appear to contain an unusual amount of PCBs, nor did the rooms in which the filter samples were taken from have other types of samples with any PCB detections above available guidance or cleanup levels.

PCB SERUM TESTING

MDPH/CEH collaborated with the CDC and the MDPH State Laboratory Institute to develop a protocol for serum PCB testing and then offered this testing to members of the Allendale School community upon request. In addition, some other residents of Pittsfield, including former students at the Allendale, requested to participate in this testing. MDPH/CEH agreed to accommodate these requests. The following sections summarize the methods and results of this effort.

METHODS

Consent Form

In order to collect blood samples, MDPH required that each participant (or parent, in the case of children) sign a consent form. MDPH/CEH developed a consent form specifically for this testing effort. The consent forms were adapted from similar consent forms previously used for participants in PCB blood testing in Berkshire County and elsewhere in Massachusetts and were reviewed and approved by the MDPH Institutional Review Board (IRB). The consent form was also approved by the MDPH Office of General Counsel and reviewed by the MDPH Health and Medical Peer Review Team. A copy of the consent form is contained in Appendix C.

Questionnaire

MDPH/CEH has developed questionnaires used in many other PCB investigations for obtaining information on risk factors that are known to or may affect serum PCB levels. For this project, previously used questionnaires were adapted to gather information that

included the following: age, gender, residential history (including duration of residence), usual occupation, occupation associated with use of PCBs, company, duration, number of years attending or working at Allendale School, locations in the school where most time was spent for up to each of the last seven school years (if applicable), time spent indoors and outdoors during the school day, fish consumption in general, freshwater fish consumption (how obtained, source, Housatonic River fish), change in fishing/fish consumption habits, fiddlehead fern gathering/consumption, recreational areas and types of activities in Pittsfield area (camping, playgrounds, dirt biking, etc), hunting/wildlife consumption (type of prey, how often), gardening (type), playing in dirt or grass at current address, farm residence, open ended question on any other contact with PCBs, breast feeding and duration (for child participant), number of prior children breast fed (for adult female parent), lifestyle risk factors (e.g., smoking). The questionnaires were administered in two parts; the more lengthy first part was administered over the phone before the blood draw and the second part was administered at the time of the blood draw. The second part of the questionnaire included questions relevant to the blood draw (i.e. weight and height) as well as questions which required the participant to view a map of the Allendale School.

Notification of PCB Testing Offer

On April 11, 2006, students, parents, faculty, and staff were sent a letter from the MDPH/CEH with an offer to conduct serum PCB sampling should any member of the Allendale community want such biologic testing. The MDPH/CEH, in partnership with the Pittsfield Board of Health, held an informational meeting on May 2, 2006, to discuss the MDPH/CEH PCB blood testing offer with members of the Allendale School community and answer any questions that people may have had prior to the actual blood testing.

Phlebotomy and Laboratory Training

MDPH contracted with Berkshire Medical Center to provide phlebotomy services to those individuals who responded to the offer to conduct serum PCB testing. BMC has provided these types of services for a number of MDPH projects in Berkshire County involving serum PCB measurements since 1995. Training for BMC staff on proper collection, preparation, and shipping procedures was provided by MDPH State Laboratory Institute staff on May 4, 2006 and May 19, 2006. Protocol specific supplies and equipment were provided by both the CDC and the MDPH State Laboratory Institute.

Sample Transport

The BMC laboratory performed blood collection processes and prepared the samples for shipping. Samples were placed on dry ice and transported by a MDPH/CEH staff member from Berkshire Medical Center to the MDPH SLI for inventory and storage until all serum samples were collected. Once all samples were collected, they were shipped overnight to the U.S. CDC in Atlanta, Georgia.

Sample Analysis

The blood testing methodology used for the biomonitoring portion of this project is a congener-specific analysis as described in the Third National Report on Human Exposure to Environmental Chemicals published by CDC in July 2005. The Third National Report presents biomonitoring exposure data for 116-148 environmental chemicals including PCBs for the civilian, non-institutionalized U.S. population over the period 1999-2002 and is a nationally representative survey from the National Health and Nutrition Examination Survey (NHANES). While children under 12 are not included in the CDC's PCB blood analyses, children are included for the 12-19 year old age group. For the 2001-2002 NHANES, 758 children in the 12-19 age category were tested for serum PCB levels.

The analytic laboratory methods used by the CDC for the serum samples from the Allendale School community are the most up to date congener specific methods available

(CDC Method HRGC/ID-HRMS, No.28). Method detection limits for PCB serum analysis are congener specific and may vary between samples, largely due to variations in sample volume (USCDC, 2005). According to the CDC the method detection limits for NHANES III range from 10.5 – 32.4 ppb (lipid-adjusted) and are typical for most methods using about 1mL of sample (USCDC, 2005). The Allendale School serum collection resulted in analysis of 2mL samples and the congener specific detection limits for these samples are approximately 10 times lower than those reported in NHANES III, i.e., 0.7 to 2.9 ppb. Similarly, detection limits for NHANES III based on whole weight basis ranged from approximately 0.01 – 0.04 ppb, while the detection limits for the Pittsfield samples ranged from approximately 0.005 – 0.02 ppb, or approximately half of NHANES. Table 5 lists method detection limits for each congener analyzed (lipid-adjusted).

The CDC analyzed serum samples for 36 congeners that are known to be detected in the serum of the general U.S. population and consistent with congeners analyzed in the ongoing NHANES study. The final list of 36 congeners was derived from the most recent NHANES data collection period of 2003/2004, which is not yet published or available.

Serum PCBs concentrations in the Pittsfield participants were compared with data from the 2001-2002 NHANES. CDC reported that the most appropriate way to compare the data is to take the most common 15 congeners identified in 2001-2002 NHANES that were also identified in Pittsfield participants and compare those. These congeners are 52, 74, 99, 105, 118, 138/158, 146, 153, 156, 170, 180, 187, 194, 199, and 204. CDC also reported that all of these congeners had at least a 95^{th} percentile value from the NHANES data [A 95^{th} percentile value means 95% of the population surveyed had serum PCB concentrations at or below this value]. For these total PCB summary calculations, non-detects were treated as the method detection limit divided by the square root of two.

NHANES reports serum PCB congener results by whole weight (ng/g of serum) and lipid-adjusted (ng/g of lipid) values for the 50^{th}, 75^{th}, 90^{th}, 95^{th} percentiles as well as

calculating a geometric mean when statistically possible. The whole weight serum values (ng/g serum) reported by the CDC can be converted to ng/mL of serum by multiplying by the average density of serum samples, 1.026 g/mL. CDC also reported that the sum of the congeners by whole weight basis most closely approximate what had been previously reported in the scientific literature based on Aroclor methods.

Historically, CDC and most researchers have conducted serum PCB testing as a whole weight as µg PCBs/L blood. However, today with advances in laboratory analytical capabilities, serum PCBs are increasingly being reported using lipid-adjustment results. PCBs are associated with fatty (lipid) fractions in the blood and tend to concentrate in these fatty or lipid fractions. Hence, lipid-adjusted concentrations are numerically higher than whole weight values due to PCBs concentrating in fatty tissue. Also, lipid-adjusted values take into account differences between people in terms of lipids in the blood. For example, if two people had the same whole weight value for serum PCBs but one had twice the concentration of lipids in the blood then the lipid-adjusted values would be half of the other one.

The Pittsfield results were also compared with available data in the scientific literature, particularly for children. These data include summary data from the 2000 ATSDR Toxicologic Profile for PCBs, as well as studies from the Netherlands, Germany, and Alabama that included PCB serum results from children.

RESULTS

The offer to test the Allendale School community for PCB serum levels resulted in 32 participants ranging in age from 8 to 59 years. Samples were taken by BMC staff from May 31, 2006, through July 27, 2006. All samples were shipped to CDC via overnight mail on August 16, 2006.

Participation in PCB serum testing included current Allendale School students, Allendale School staff, and other concerned area residents, including former Allendale students and

those living near or parents of children attending the Allendale School. Samples were collected for 14 children (ages 8-19 years) and 18 adults (ranging from 20-59 years of age). Among the children were 7 current Allendale students, 5 former Allendale students and two others. Among adults, four current Allendale School staff participated in serum PCB testing. A summary of the participant distribution by age and gender is included in Table 6.

PCB congener results were reported by the CDC on a serum whole weight (ppt, pg/g) and lipid-adjusted basis (ppb, ng/g) consistent with reporting results in NHANES. PCB congeners 138,158 and congeners 196,203 are co-congeners that cannot be separated by this methodology and are reported together. PCB congener 18 was not reported because one or more of the quality assurance/quality control (QA/QC) parameters did not meet the specified criteria. CDC reports that this is a common result for congener 18 for all labs and that this congener is a minor contributor to total serum PCBs.

Serum PCBs in Children Ages 8-19 Years Old

A total of 14 children participated in the serum PCB testing effort. Seven children were current Allendale students, aged 8-10 years. The median (or 50th percentile) of total PCBs, (15 congeners, whole weight) for the current Allendale students was 0.117 ppb (Table 9). This compares to the NHANES 50th percentile value (12-19 year olds) of 0.345 ppb. All Allendale students had serum PCB levels below the CDC 50th percentile. (see Table 9).

As previously discussed, current analytical methods result in lipid-adjusted serum PCB concentrations as well. Lipid-adjusted concentrations are reported in ng PCBs/g lipid (fat) in the blood. PCBs preferentially store in fatty tissue and hence lipid-adjusted concentrations will be higher numbers reflecting the fact that PCBs are more concentrated in fatty tissue. For example, one of the Pittsfield child participants had a serum PCB level of 0.124 ppb (whole weight) and 31.4 ppb (lipid-adjusted). Both of these values are well below the corresponding 50th percentile for NHANES.

For the seven current Allendale students the median lipid-adjusted total PCB concentrations in serum, based on summing 15 congeners, was 25.2 ppb. This compares to the NHANES 50th percentile of 71.8 ppb (12-19 year olds). All seven students were below the NHANES 50th percentile for 12-19 year olds.

The other seven children were aged 12-19, or the same age cohort for which CDC has comparison data from NHANES. Among the seven were five former Allendale students. Median (50th percentile) serum PCB levels (15 congeners) were 0.141 ppb (whole weight). This compares to the NHANES 50th percentile of 0.345 ppb (12-19 year olds). Five of these children had serum PCB concentrations lower than the 50th percentile value from NAHNES for this age group, while the remaining two were less than the 90th percentile value.

Lipid-adjusted results based on the sum of 15 congeners for these seven children showed a median of 26.2 ppb. The NHANES lipid-adjusted 50th percentile for this age group was 71.8 ppb. All individuals were less than the NHANES 90th percentile value (113.7 ppb, with a confidence interval of 103.5 - 133.1 ppb) for lipid-adjusted serum PCB concentrations.

Serum PCBs in Adults (Aged 20 or more years)

A total of 18 adults participated in the serum PCB testing. Of these, four were current Allendale School staff, 6 were parents of current students at the school, and the remainder were individuals living near the school or elsewhere in Pittsfield or neighboring communities. The median serum PCB level in adults (summing all 15 congeners) was 0.918 ppb (whole weight) (Table 8). This compares to the NHANES 50th percentile value in ages 20+ of 1.062 ppb. The median serum PCB level for the four Allendale staff was 1.618 ppb, or above the NHANES 50th percentile (1.062) but below the 75th percentile (1.883 ppb). As with the results for children, all adult participants had serum PCB levels less than the NHANES 90th percentile value.

Lipid-adjusted summary data showed similar results. The median serum PCB concentration (15 congeners) was 176.1 ppb. This compares with the NHANES 50th percentile (lipid-adjusted) of 168.5 ppb. CDC also reported a 95 percent confidence interval around the 50th percentile of 154.7 – 184.2 ppb. The 95 percent confidence interval is the range of estimated values that have a 95% probability of including the true 50th percentile value for the population. Thus, because the median for Pittsfield adults was within the confidence interval of the NHANES 50th percentile serum PCB level, the Pittsfield participants had serum PCB levels consistent with the general US adult population. For the current Allendale staff, the median lipid-adjusted value was 263.1 ppb, or between the NHANES 50th and 75th percentile (the latter is 291.8 ppb).

As is well established in the scientific literature, serum PCB levels are higher as age increases. Although numbers were small, this trend was also observed among the Pittsfield adult participants. Three individuals in the age range of 20-39 showed median (whole weight) total PCB concentration (15 congeners) of 0.698 ppb; nine individuals aged 40-49 showed a median concentration of 0.831 ppb; and six individuals aged 50-59 showed a median concentration of 1.554 ppb.

Comparison of Congener Detections

In this report, data have been provided on total PCBs based on summing 15 congeners tested for. Figure 4 shows the distribution of detection frequencies of 31 of the 35 congeners analyzed by CDC in the Pittsfield adult participants. These frequencies are also provided in Figure 5 for adults from the NHANES data. The congener patterns observed for Pittsfield and NHANES are similar, suggesting similarities with what is found in the US population. In addition, in response to discussions held with the HMPRT, we asked CDC whether congener patterns in Pittsfield differed from those they typically see in the U.S. population. CDC noted that their review did not reveal any unusual patterns among the Pittsfield participants to suggest that exposures that may have led to any evidence of PCBs in blood samples are different than the U.S. population (see Appendix F).

Figure 4 also shows that the 15 congeners selected by CDC for comparing Pittsfield with NHANES data, are indeed the most prevalent congeners found in the general U.S. population.

DISCUSSION

Children

Results of the serum PCB testing for Pittsfield children show that participants, especially current Allendale students, had low levels when compared with national data from NHANES, as provided by CDC. The Allendale students had a median serum PCB level (whole weight) of 0.117ppb, well below the NHANES value of 0.345 ppb. Similar results were seen for lipid-adjusted serum PCBs. Similar to the Allendale students, children that were not currently students at the Allendale also had median serum PCB levels lower than comparable NHANES data.

In addition to NHANES data, there have been a limited number of scientific publications documenting serum PCB testing results in children and these are summarized here for comparison to the Pittsfield results. In a study that included Dutch children aged 3.5 years old considered to have "background" levels of exposure to PCBs, serum samples were analyzed for four specific congeners: 118, 138, 153, and 180 (Lanting et al. 1998). Results from 298 children showed a 50^{th} percentile concentration of 0.4 ppb and 95^{th} percentile concentration of 1.9 ppb (units of µg/L). Among the Pittsfield children closest in age (the seven Allendale children aged 8-10 years), the 50^{th} percentile value of the sum of these four congeners (plus 158, which was reported as part of the 138/158 pair) was 0.0758 ppb with a maximum of 0.137 ppb, or less than the 50^{th} percentile from the Dutch study.

In a study of German children aged 7-10 years old in 18 German townships (Karmaus et al., 2005), serum PCB concentrations were measured for the following congeners: 101,

118, 138, 153, 170, 180, 183, and 187. The geometric mean PCB levels (µg/L) were as follows:

- 7 year olds (n=153): 0.54 ppb
- 8 year olds (n=160): 0.47 ppb
- 9-10 year olds (n=12): 0.33 ppb

Summarizing these same congeners (plus 158, as this was analyzed with congener 138) in the current Allendale students (age 8-10 years), the maximum total PCBs for these congeners was 0.156 ppb with a geometric mean of 0.0840 ppb, all well below the concentrations reported in Karmans et. al.

Finally, CDC conducted a study of children in Anniston, Alabama (Orloff et al. 2003). This community was the site of a plant that formerly manufactured PCBs from 1935 to the 1970s. Serum samples were analyzed or 37 PCB congeners. A total of 37 children (aged 1-16 years) participated in this study. The total PCB concentration ranged from non-detect to 4.6 ppb (µg/L) (whole weight). The mean concentration in children was 0.37 ppb, while the median was non-detect (detection limit < 1 ppb). Assuming the PCB concentrations in the samples without detectable PCBs to be one-half the detection level, the mean and median concentrations in children were calculated to be 1.59 and 1.10 ppb, respectively (Orloff et al. 2003). The total serum PCB median concentration among the 14 Pittsfield children (sum of all 35 congeners), assuming non-detected congeners as one-half the detection limit divided by the square root of two, was 0.170 ppb, well below the Anniston children median.

Adults

Adult participants had serum PCB levels consistent with NHANES data. The median serum PCB level was 0.918 (whole weight) versus the comparable NHANES level of 1.062 ppb. All adult participants had serum PCB levels less than the NHANES 90th percentile.

The ATSDR Toxicologic Profile for PCBs (2000) reports that serum PCB levels have been declining in the U.S. population. They report on more recent studies of non-occupationally exposed populations that do not consume fish from PCB-contaminated waters (ATSDR 2000). Geometric mean serum PCB levels in these populations ranged from 0.9 to 1.5 ppb (µg/L), with a range among individuals in these populations of 0.46 to 9.5 ppb (ATSDR 2000). Among the adult participants in Pittsfield, the geometric mean serum PCB level (all congeners, whole weight) was 1.150 ppb, with a maximum concentration of 3.595 ppb. CDC reported their whole weight PCB concentrations on a ng/g basis. Converting to µg/L, for comparison to the ATSDR reported data, results in a geometric mean of 1.18 ppb, with a max of 3.688 ppb. Thus, the Pittsfield adult participants had serum PCB levels consistent with data cited in ATSDR 2000.

CONCLUSIONS

Results from indoor environmental and serum PCB testing at the Allendale School did not appear to reveal unusual opportunities for PCB exposures to the Allendale School community or to other participants in the serum PCB testing. Although PCBs were detected in some indoor environmental samples, with one exception (of 98 samples), no detection of either Aroclors or congeners exceeded any available screening guideline or regulatory standards. The one exception was a slight exceedance (0.144 ug/wipe) for a sample taken from a windowsill in the gymnasium located 10 feet above floor level. This sample result was, however, well below the USEPA cleanup standard for determining whether more aggressive cleaning may be needed for a surface.

Although 5 of 98 samples slightly exceeded at least one available guideline assuming non-detectable Aroclors or congeners were assumed to be present at one-half the detection limit, these concentrations under the most conservative exposure assumptions would not be expected to result in health effects. In addition, levels reported in the Allendale School were generally lower than those reported in other studies in Massachusetts, North Carolina, and Great Britain for indoor environments, including

schools, day care centers, and homes. Finally, levels reported for indoor air in the school were below health-based screening values and consistent with historical data that show that PCBs are more frequently detected during warmer months in outdoor air samples at concentrations slightly higher than during colder months of the year.

Serum PCB testing conducted using state-of-the-art analytical techniques by the U.S. CDC showed that the current Allendale students (participants were aged 8-10) were well below available national data for children aged 12-19 years old. In addition, comparison with available data for children in the scientific literature also revealed that the Allendale children had lower serum PCB levels to those reported in the literature. Adult participants, including current Allendale School staff, also showed typical serum PCB levels based on the national NHANES data, including the fact that there was a trend of serum PCB levels increasing with age, a well-established trend for serum PCBs. The median concentration in Pittsfield adults (0.918 ppb whole weight) was less than the comparable NHANES value (1.062 ppb) and all adults had levels within the NHANES 90^{th} percentile (3.099 ppb whole weight).

RECOMMENDATIONS

The following recommendations are provided:

1. MDPH/CEH recommends that more aggressive cleaning of surfaces not routinely cleaned (e.g., windowsills) be undertaken and regularly conducted.
2. MDPH/CEH will respond to any public comments received on this public comment release report and prepare a final report that includes responses to all comments received.
3. At the request of the Pittsfield Board of Health and/or community residents MDPH/CEH will evaluate any ambient air results of testing being conducted by the US EPA that may be of concern.

REFERENCES

ATSDR. 2005. Public Health Assessment Guidance Manual (Update). Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. January 2005.

ATSDR. 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry.

Beta. 2006. Letter and attachments from David Billo, Senior Project Manager and Alan D. Hanscom, Associate, at Beta Group, Inc., to Scott Alfonse, Environmental Stewardship Director, New Bedford, Massachusetts. May 31, 2006.

CDTSC. 2003. PCB Advisory for Schools: How Voluntary Lighting Retrofits Can Address Hidden Dangers. California Department of Toxic Substances Control. June 2003.

Currado, Gian Marco and Stuart Harrad. 1998. Comparison of Polychlorinated Biphenyl Concentrations in Indoor and Outdoor Air and the Potential Significance of Inhalation as a Human Exposure Pathway. *Environmental Science & Technology*. Volume 32: pp. 3043-3047.

DeCaprio, Anthony P., Glenn W. Johnson, Alice M. Tarbell, David O. Carpenter, Jeffrey R. Chiarenzelli, Gayle S. Morse, Azara L. Santiago-Rivera, Maria J. Schymura, and Akwesasne Task Force on the Environment. 2005. Polychlorinated biphenyl (PCB) exposure assessment by multivariate statistical analysis of serum congener profiles in an adult Native American population. *Environmental Research*. Volume 98: pp 284-302.

DeCaprio, Anthony P., Alice M. Tarbell, Amelie Bott, Dana L. Wagemaker, Randy L. Williams, and Colleen M. O'Hehir. 2000. Routine analysis of 101 polychlorinated biphenyl congeners in human serum by parallel dual-column gas chromatography with electron capture detection. *Journal of Analytical Toxicology*. Volume 24: pp 403-420.

EH&E. 1995a. Assessment of airborne pesticide levels at Bourne schools in Bourne, MA. Draft letter dated September 6, 1995, to Emcon Wehran Engineering from Environmental Health and Engineering, Inc., Newton, MA.

EH&E. 1995b.Assessment of vapor phase PCB levels at Bourne schools in Bourne, MA. Draft letter dated September 11, 1995, to Emcon Wehran Engineering from Environmental Health and Engineering, Inc., Newton. MA

MDPH. 2003. Public Health Assessment for General Electric Site- Hill 78 Area. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

NETL. 1996. Laboratory data sheets, New England Testing Laboratory, North Providence, RI.

Rudel, Ruthann A., David E. Camann, John D. Spengler, Leo R. Korn, and Julia G. Brody. 2003. Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting compounds in indoor air and dust. *Environmental Science & Technology.* Volume 37, Number 20: pp: 4543-4553.

USCDC. 2005. Centers for Disease Control and Prevention Third National Report on Human Exposure to Environmental Chemicals. Pgs. 135-139, 174-249, 459-461. July 2005.

USEPA. 2004. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. USEPA Office of Superfund Remediation and Technology Innovation. July 2004.

USEPA. 1997a. Integrated Risk Information System. www.epa.gov/iris

USEPA. 1997b. Exposure Factors Handbook. August 1997.

Vorhees, Donna J., Alison C. Cullen, and Larisa M. Altshul. 1999. Polychlorinated biphenyls in house dust and yard soil near a Superfund site. *Environmental Science & Technology*. Volume 33, Number 13: pp. 2151-2156.

Vorhees, Donna J., Alison C. Cullen, and Larisa M. Altshul. 1997. Exposure to Polychlorinated Biphenyls in Residential Indoor Air and Outdoor Air near a Superfund Site. *Environmental Science & Technology*. Volume 31, Number 12: pp. 3612-3618.

Wilson, Nancy K., Jane C. Chuang, and Christopher Lyu. 2001. Levels of persistent organic pollutants in several child day care centers. *Journal of Exposure Analysis and Environmental Epidemiology.* Volume 11, Issue 6: pp. 449-458.

Wilson, Nancy K. Personal communication with Michael Celona, Senior Environmental Analyst, MDPH. September 6, 2006.

www.wundergound.com 2006.

Table 1: Sample Locations

Sample Type	Locations
Surface Wipe ($\mu g/100\ cm^2$)	Classroom 19, Classroom 23, Classroom 24, Classroom 27, Classroom 28, Classroom 32, Hallway Outside Classroom 15, Hallway Outside Classroom 21, Hallway Outside Classroom 29, Hallway Outside Gymnasium, Health Office, Gymnasium
Air ($\mu g/m^3$)	Classroom 21, Classroom 28, Outside between Classrooms 23 and 24
Carpet Surface Dust (mg/kg)	Classroom 19
Vacuum Bag (mg/kg)	Entire School
Unit Ventilator Filter	Classroom 21, Classroom 24

Table 2: Method Detection Limits

Sample Type	Analysis	Laboratory	Method Detection Limit
Surface Wipe (µg/wipe)	Aroclor	SAI	0.05
		SWRI	0.050
	Congener	SUNY	0.00028
		SWRI	0.0050
Air ($\mu g/m^3$)	Aroclor	SAI	0.000011
		SWRI	0.000067
	Congener	SUNY	0.0000093
		SWRI	0.0000058
Carpet Surface Dust (mg/kg)	Aroclor	SAI	0.047
		SWRI	0.100
	Congener	SUNY	0.00025
		SWRI	0.0050
Vacuum Bag (mg/kg)	Aroclor	SAI	0.250
		SWRI	0.0994
	Congener	SUNY	0.00025
		SWRI	0.0098
Unit Ventilator Filter (mg/kg)	Aroclor	SAI	0.103
		SWRI	0.050
	Congener	SUNY	0.00013
		SWRI	0.0025

Table 3: Sample Results

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
Air (µg/m3)						
Room 21 (A)	Aroclor	SAI		0.000566	0.000654	CREG-0.01 µg/m^3
		SWRI		0.00181	0.00220	
	Congener	SUNY		0.00688	0.00704	
		SWRI	50% J	0.000450	0.000934	
Room 21 (B)	Aroclor	SAI		0.000588	0.000676	
		SWRI		0.00180	0.00219	
	Congener	SUNY		0.00491	0.00507	
		SWRI	40% J	0.000450	0.000964	
Room 28 (A)	Aroclor	SAI		0.000590	0.00069	
		SWRI		0.00232	0.00277	
	Congener	SUNY		0.0112	0.0114	
		SWRI	50% J	0.000988	0.00135	
Room 28 (B)	Aroclor	SAI		0.000642	0.000734	
		SWRI		0.00291	0.00333	
	Congener	SUNY		0.00864	0.00879	
		SWRI	40% J	0.00109	0.00148	
Outside (A)	Aroclor	SAI		0.000412	0.000496	
		SWRI		0.00143	0.00181	
	Congener	SUNY		0.0116	0.0117	
		SWRI	70% J	0.000392	0.000707	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
Outside (B)	Aroclor	SAI		0.000341	0.000425	
		SWRI		0.00152	0.00190	
	Congener	SUNY		0.00779	0.00793	
		SWRI	70% J	0.000432	0.000751	
Field Blank 1	Aroclor	SAI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
		SWRI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
	Congener	SUNY	Detections in field blank	1.600 µg/mL	1.885 µg/mL	
		SWRI		ND (0.0002 µg/SPL)	ND (0.0002 µg/SPL)	
Field Blank 2	Aroclor	SAI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
		SWRI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
	Congener	SUNY	Detections in field blank	0.699 µg/mL	1.029 µg/mL	
		SWRI		ND (0.0002 µg/SPL)	ND (0.0002 µg/SPL)	
Matrix Blank 1	Aroclor	SAI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
		SWRI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
	Congener	SUNY	Detections in matrix blank	0.247 µg/mL	0.610 µg/mL	
		SWRI		ND (0.0002 µg/SPL)	ND (0.0002 µg/SPL)	
Matrix Blank 2	Aroclor	SAI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
		SWRI		ND (0.020 µg/PUF)	ND (0.020 µg/PUF)	
	Congener	SUNY	Detections in matrix blank	0.505 µg/mL	0.832 µg/mL	
		SWRI		ND (0.0002 µg/SPL)	ND (0.0002 µg/SPL)	
Surface Wipes (µg/wipe)						

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
Room 19 (A)	Aroclor	SAI		ND (0.05)	ND (0.05)	CDTSC- 0.1 µg/wipe USEPA- 10 µg/wipe
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.000150	0.0126	
		SWRI		ND (0.005)	ND (0.005)	
Room 19 (B)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		ND (0.00014)	ND (0.00014)	
		SWRI		ND (0.005)	ND (0.005)	
Room 19 (C)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.000230	0.0127	
		SWRI		ND (0.005)	ND (0.005)	
Room 19 (D)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.000130	0.0126	
		SWRI		ND (0.005)	ND (0.005)	
Room 24 (A)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00188	0.0139	
		SWRI		ND (0.005)	ND (0.005)	
Room 24 (B)	Aroclor	SAI		ND (0.05)	ND (0.05)	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		ND (0.00014)	ND (0.00014)	
		SWRI		ND (0.005)	ND (0.005)	
Room 24 (C)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00020	0.0126	
		SWRI		ND (0.005)	ND (0.005)	
Room 24 (D)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00011	0.0126	
		SWRI		ND (0.005)	ND (0.005)	
Room 28 (A)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00350	0.0153	
		SWRI		ND (0.005)	ND (0.005)	
Room 28 (B)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00030	0.0127	
		SWRI		ND (0.005)	ND (0.005)	
Room 28 (C)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
	Congener	SUNY		0.00030	0.0127	
		SWRI		ND (0.005)	ND (0.005)	
Room 28 (D)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.0010	0.0134	
		SWRI		ND (0.005)	ND (0.005)	
Room 32 (A)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00070	0.0130	
		SWRI		ND (0.005)	ND (0.005)	
Room 32 (B)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00108	0.0134	
		SWRI		ND (0.005)	ND (0.005)	
Room 32 (C)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00197	0.0141	
		SWRI		ND (0.005)	ND (0.005)	
Room 32 (D)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00028	0.0127	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
		SWRI		ND (0.005)	ND (0.005)	
Hall (A)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00009	0.0126	
		SWRI		ND (0.005)	ND (0.005)	
Hall (B)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00009	0.0126	
		SWRI		ND (0.005)	ND (0.005)	
Hall (C)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		ND (0.00014)	ND (0.00014)	
		SWRI		ND (0.005)	ND (0.005)	
Hall (D)	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00023	0.0127	
		SWRI		ND (0.005)	ND (0.005)	
Gymnasium Windowsill	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		0.144	0.294	
	Congener	SUNY		0.04003	0.0467	
		SWRI	75% J	0.0702	0.280	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
Health Office Vent	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.0132	0.0218	
		SWRI	100% J	0.0061	0.259	
Room 23 Pipe	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		ND (0.0125)	ND	
		SWRI		ND (0.005)	ND (0.005)	
Room 24 Storage Bin Cover	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00154	0.0135	
		SWRI		ND (0.005)	ND (0.005)	
Room 24 Unit Ventilator	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00137	0.0135	
		SWRI		ND (0.005)	ND (0.005)	
Room 27 Ceiling Fan Blade	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00193	0.0139	
		SWRI		ND (0.005)	ND (0.005)	
Room 28 VCR	Aroclor	SAI		ND (0.05)	ND (0.05)	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		0.00214	0.0142	
		SWRI		ND (0.005)	ND (0.005)	
Field Blank	Aroclor	SAI		ND (0.05)	ND (0.05)	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY		ND (0.00014)	ND (0.00014)	
		SWRI		ND (0.005)	ND (0.005)	
Carpet Dust (mg/kg)						
Room 19	Aroclor	SAI		0.0592	0.238	Chronic Child EMEG (for soil)- 1 mg/kg Chronic Adult EMEG (for soil)- 10 mg/kg CREG (for soil)- 0.4 mg/kg
		SWRI		ND (0.100)	ND (0.100)	
	Congener	SUNY		0.108	0.111	
		SWRI	100% J	0.0762	0.526	
Vacuum Bags (mg/kg)						
Bag 1	Aroclor	SAI		0.285	1.285	Chronic Child EMEG (for soil)- 1 mg/kg Chronic Adult EMEG (for soil)- 10 mg/kg CREG (for soil)- 0.4 mg/kg
		SWRI		ND (0.099)	ND (0.099)	
	Congener	SUNY		0.0513	0.0559	
		SWRI	80% J	0.0687	0.534	
Bag 2	Aroclor	SAI		0.292	1.292	
		SWRI		ND (0.099)	ND (0.099)	
	Congener	SUNY		0.0666	0.0709	
		SWRI	90% J	0.0601	0.502	

Location	Analysis	Laboratory	QA/QC Notes	Result (ND=0)	Result (half ND)	Comparison Values
Unit Ventilator Filters (µg/vent)						
Room 21	Aroclor	SAI		ND (99.8)*	ND (99.8)*	N/A
		SWRI		0.0743	0.224	
	Congener	SUNY		0.0467	0.0519	
		SWRI	100% J	0.0288	0.259	
Room 24	Aroclor	SAI		ND (106)*	ND (106)*	
		SWRI		0.105	0.255	
	Congener	SUNY		0.0742	0.0786	
		SWRI	80% J	0.0907	0.278	
Field Blank	Aroclor	SAI		ND (87)*	ND (87)*	
		SWRI		ND (0.05)	ND (0.05)	
	Congener	SUNY	Detections in field blank	0.00294	0.0155	
		SWRI		ND (0.005)	ND (0.005)	
NIST SRM (mgkg)						
Prepared Sample	Congener	SUNY	81 congeners detected	0.39	0.40	
		SWRI	41 congeners detected; 60% J	0.4463	0.7521	

SAI reported filters in µg/kg.

Table 4: Summary of Indoor Environmental Testing Results

Sample Type	Analysis	Detects/Samples	QA/QC Notes	Max *	Max**	Screening Values
Surface Wipe ($\mu g/100\ cm^2$)	A-SAI	0/27	None	-----	-----	0.1 (CDTSC) 10 (USEPA)
	A-SWRI	1/27	None	0.144	0.294	
	C-SWRI	2/27	90% J	0.07	0.28	
	C-SUNY	23/27	None	0.040	0.047	
Indoor Air ($\mu g/m^3$)	A-SAI	4/4	None	0.00064	0.00073	0.01 (ATSDR CREG)
	A-SWRI	4/4	None	0.00291	0.00333	
	C-SWRI	4/4	50% J	0.00109	0.00148	
	C-SUNY	4/4	Blank detects	0.0112	0.0114	
Outdoor Air ($\mu g/m^3$)	A-SAI	2/2	None	0.00041	0.00050	0.01 (ATSDR CREG)
	A-SWRI	2/2	None	0.00091	0.0019	
	C-SWRI	2/2	50% J	0.00041	0.00075	
	C-SUNY	2/2	Blank detects	0.0116	0.0117	
Carpet Dust (mg/kg)	A-SAI	1/1	None	0.059	0.238	0.4 (ATSDR CREG) 1 (ATSDR Child EMEG) 10 (ATSDR Adult EMEG) 2 (MDEP)
	A-SWRI	0/1	None	-----	-----	
	C-SWRI	1/1	90% J	0.076	0.526	
	C-SUNY	1/1	None	0.108	0.111	
Vacuum Dust (mg/kg)	A-SAI	2/2	None	0.292	1.29	0.4 (ATSDR CREG) 1 (ATSDR Child EMEG) 10 (ATSDR Adult EMEG) 2 (MDEP)
	A-SWRI	0/2	None	-----	-----	
	C-SWRI	2/2	90% J	0.0687	0.534	
	C-SUNY	2/2	None	0.066	0.07	
Unit Ventilator Filter (µg/sample)	A-SAI	0/2	None	-----	-----	N/A
	A-SWRI	2/2	None	0.105	0.255	
	C-SWRI	2/2	75% J	0.0907	0.268	
	C-SUNY	2/2	None	0.0742	0.08	

A-SAI = Aroclor analysis by SAI; also A-SWRI C-SWRI = congener analysis by SWRI; also C-SUNY
Max* = maximum concentration assuming non-detected Aroclors or congeners were zero.
Max** = maximum concentration assuming non-detected Aroclors or congeners were present at ½ detection limit.
CREG = Cancer Risk Evaluation Guide
Adult/Child EMEG = Environmental Media Evaluation Guide for Adult/Children (non-cancer effects)
J = Estimated concentration below the method detection limit

Table 5

CDC METHOD DETECTION LIMITS* PPB (Lipid Adjusted)			
	PCB Congener	**NHANES III (All Ages)**	**PITTSFIELD (8-59yo)**
1	**PCB18**	NR	NR
2	**PCB28**	32.4	2.9
3	**PCB52**	12.4	1.4
4	**PCB49**	NR	1.4
5	**PCB44**	NR	0.7
6	**PCB74**	10.5	0.7
7	**PCB66**	12.4	1.4
8	**PCB101**	10.5	0.7
9	**PCB99**	10.5	0.7
10	**PCB87**	10.5	0.7
11	**PCB110**	10.5	0.7
12	**PCB118**	10.5	0.7
13	**PCB105**	10.5	0.7
14	**PCB151**	10.5	0.7
15	**PCB149**	10.5	0.7
16	**PCB146**	10.5	0.7
17	**PCB153**	10.5	0.7
18	**PCB138-158**	10.5	0.7
19	**PCB128**	10.5	0.7
20	**PCB167**	10.5	0.7
21	**PCB156**	10.5	0.7
22	**PCB157**	10.5	0.7
23	**PCB178**	10.5	0.7
24	**PCB187**	10.5	0.7
25	**PCB183**	10.5	0.7
26	**PCB177**	10.5	0.7
27	**PCB172**	10.5	0.7
28	**PCB180**	10.5	0.7
29	**PCB170**	10.5	0.7
30	**PCB189**	10.5	0.7
31	**PCB199**	10.5	0.7
32	**PCB196-203**	10.5	0.7
33	**PCB195**	28.1	0.7
34	**PCB194**	10.5	0.7
35	**PCB206**	28.1	0.7
36	**PCB209**	NR	0.7

NR= Not Reported

*Detection limits vary with samples size. Maximum detection limits among the samples analyzed are reported in this table for both NHANES and Pittsfield.

Table 6: Distribution of Participants

Age (years)	*Currently Affiliated with AS			Not Currently Affiliated with AS			Total Participants		
	Male	Female	Subtotal	Male	Female	Subtotal	Male	Female	Totals
0-19	4	3	7	2	5	7	6	8	14
20-59	2	8	10	5	3	8	7	11	18
Total	6	11	17	7	8	15	13	19	32

* Students, Parents, Staff

Table 7: Summary of Total PCB Concentrations for Children

SUM OF CONGENERS (15) 52, 74, 99, 105, 118, 138+158, 146, 153, 156, 170, 180, 187, 194, 196+203, 199	
Pittsfield Serum Samples n=14 (AGES 8-19)	**NHANES Serum Samples (AGES 12-19)**
SUM OF PCBs - Whole Weight (ppb)	
MEDIAN	**MEDIAN/50th Percentile**
0.121	0.345
SUM OF PCBs - Lipid Adjusted (ppb)	
25.7	71.8

Table 8: Summary of Total PCB Concentrations for Adults

SUM OF CONGENERS (15) 52, 74, 99, 105, 118, 138+158, 146, 153, 156, 170, 180, 187, 194, 196+203, 199	
Pittsfield Serum Samples n=18 (AGES 20-59)	**NHANES Serum Samples (AGES 20+)**
SUM OF PCBs - Whole Weight (ppb)	
MEDIAN	**MEDIAN/50th Percentile (CI)**
0.918	1.062 (0.968,1.177)
SUM OF PCBs - Lipid Adjusted (ppb)	
176.1	168.5 (154.7,184.2)

CI = Confidence Interval

Table 9: Comparison of Total* PCB Serum Levels for Current Allendale Students

CHILDREN PCB Serum Levels	ALLENDALE MEDIAN		NHANES MEDIAN/50TH PERCENTILE	
	WHOLE WEIGHT	LIPID ADJUSTED	WHOLE WEIGHT	LIPID ADJUSTED
Current Allendale Students 8-10yo. (n=7)	0.117 ppb	25.2 ppb	0.345 ppb (0.340,0.362)	71.8 ppb (69.1,74.2)
Allendale graduates and other community members 12-19yo (n=7)	0.141 ppb	26.2 ppb		

*The total of 15 most frequently detected PCB congeners in the population.

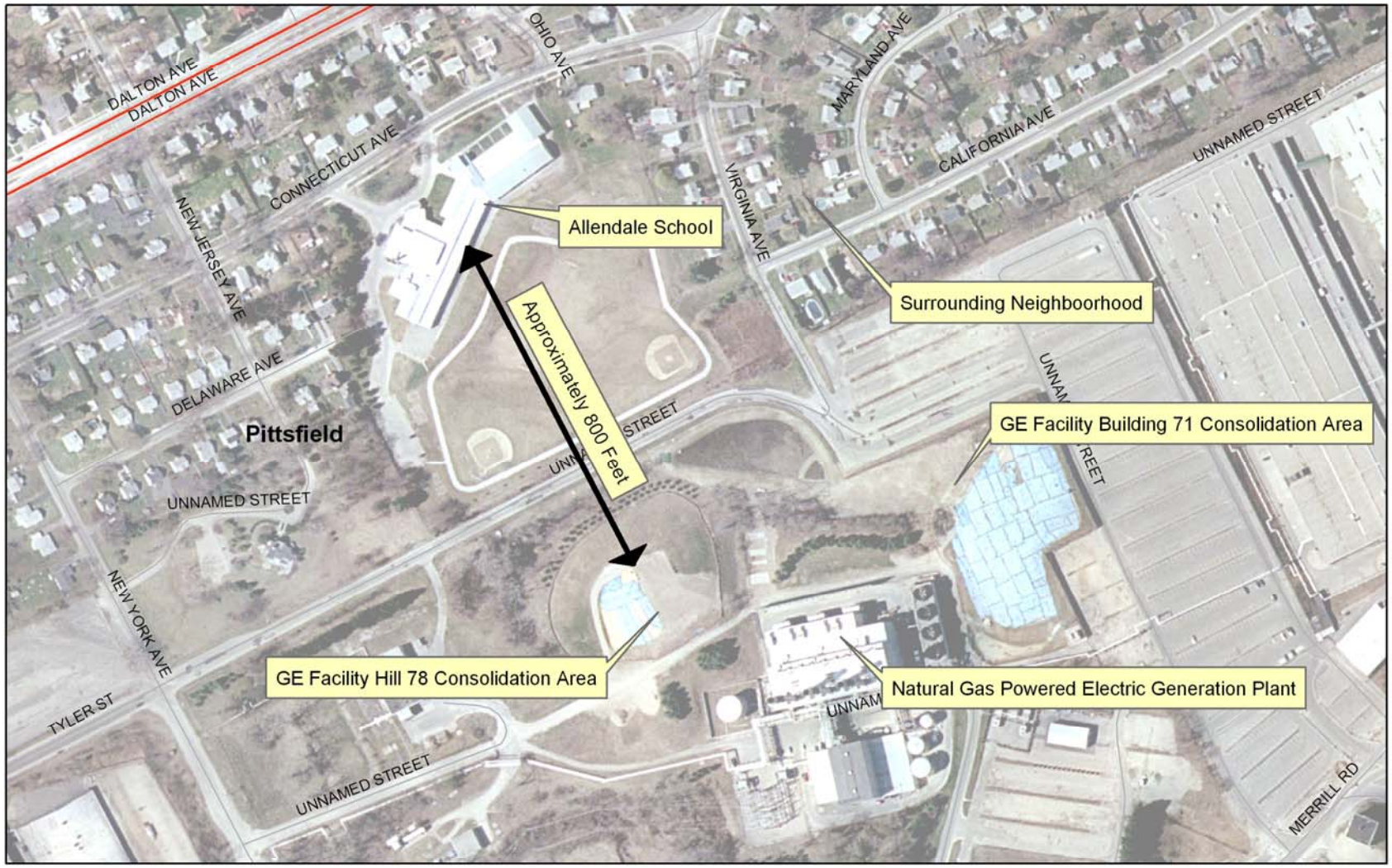


Figure 1. Allendale School, Pittsfield, Massachusetts

Figure 2. Allendale School Floor Plan

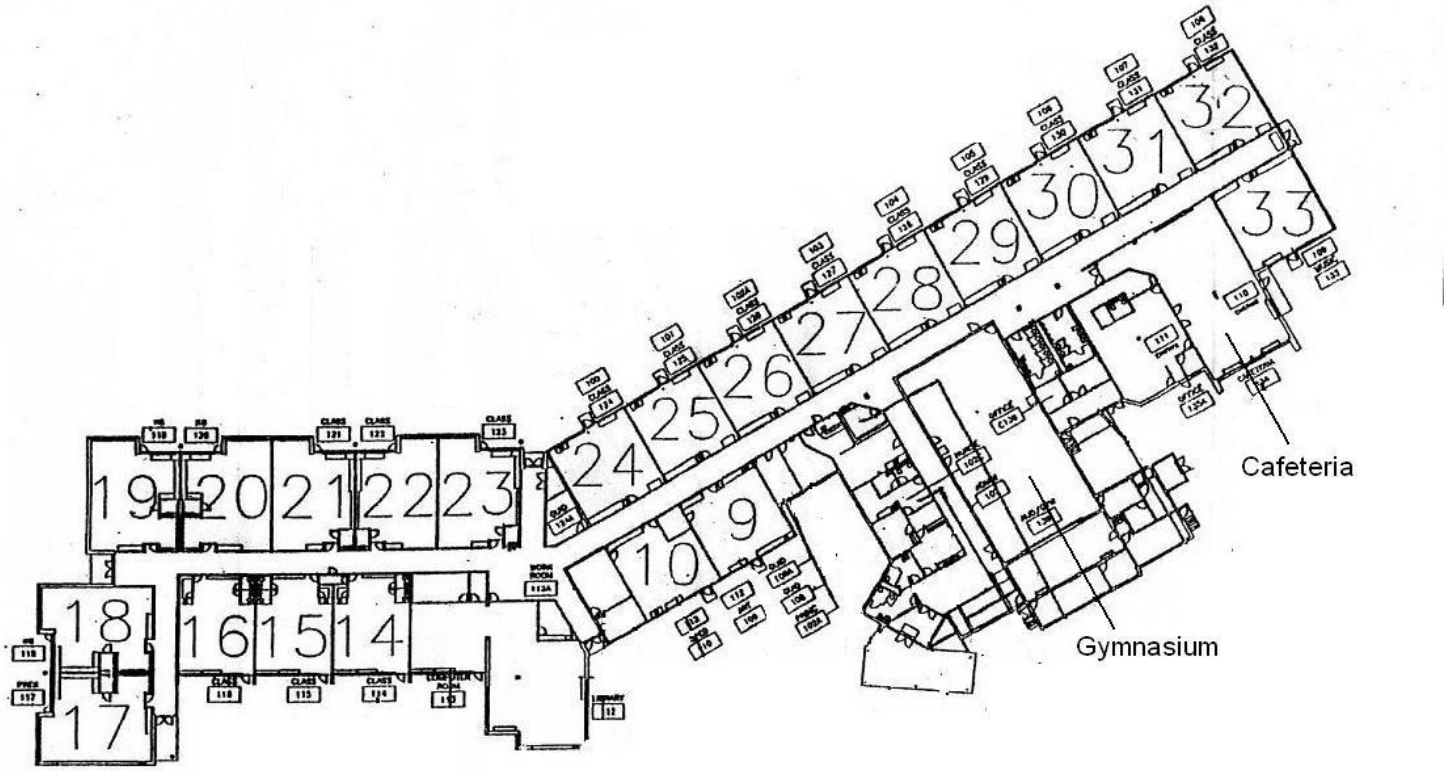


Figure 3

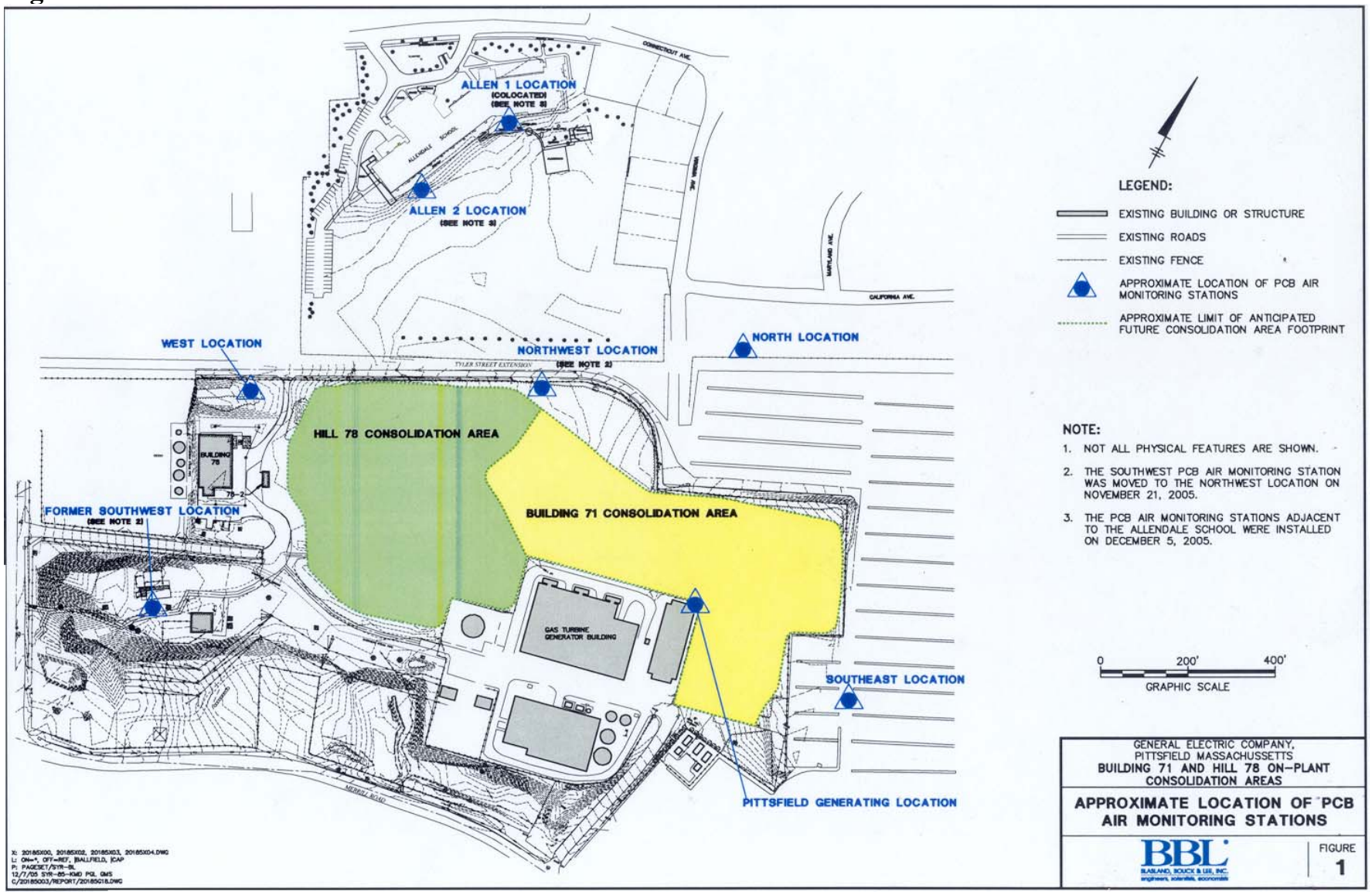

ALLEN 1 LOCATION
(COLOCATED)
(SEE NOTE 3)
ALLEN 2 LOCATION
(SEE NOTE 3)
WEST LOCATION
NORTHWEST LOCATION
(SEE NOTE 2)
NORTH LOCATION
HILL 78 CONSOLIDATION AREA
BUILDING 71 CONSOLIDATION AREA
FORMER SOUTHWEST LOCATION
(SEE NOTE 2)
SOUTHEAST LOCATION
PITTSFIELD GENERATING LOCATION
GAS TURBINE GENERATOR BUILDING
BUILDING 78
79-2
CONNECTICUT AVE.
MARYLAND AVE.
CALIFORNIA AVE.
TYLER STREET EXTENSION
MERRILL ROAD
LEGEND:
EXISTING BUILDING OR STRUCTURE
EXISTING ROADS
EXISTING FENCE
APPROXIMATE LOCATION OF PCB AIR MONITORING STATIONS
APPROXIMATE LIMIT OF ANTICIPATED FUTURE CONSOLIDATION AREA FOOTPRINT
NOTE:
1. NOT ALL PHYSICAL FEATURES ARE SHOWN.
2. THE SOUTHWEST PCB AIR MONITORING STATION WAS MOVED TO THE NORTHWEST LOCATION ON NOVEMBER 21, 2005.
3. THE PCB AIR MONITORING STATIONS ADJACENT TO THE ALLENDALE SCHOOL WERE INSTALLED ON DECEMBER 5, 2005.
0
200'
400'
GRAPHIC SCALE
GENERAL ELECTRIC COMPANY,
PITTSFIELD MASSACHUSSETTS
BUILDING 71 AND HILL 78 ON-PLANT CONSOLIDATION AREAS
APPROXIMATE LOCATION OF PCB AIR MONITORING STATIONS
BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists
FIGURE
1

Figure 4

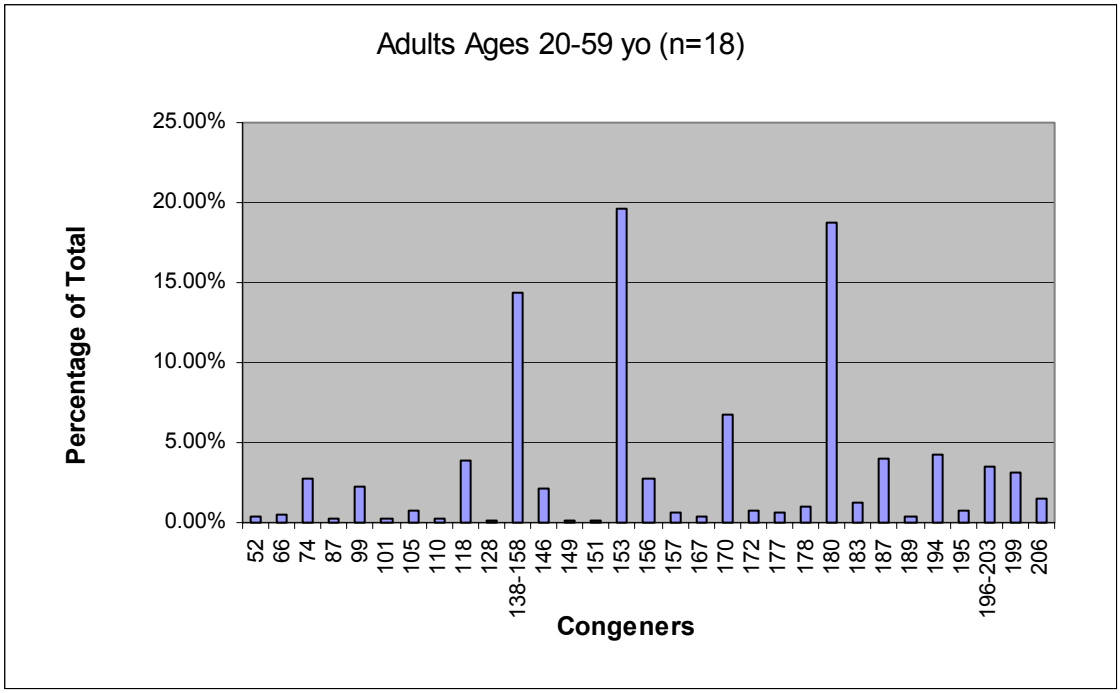
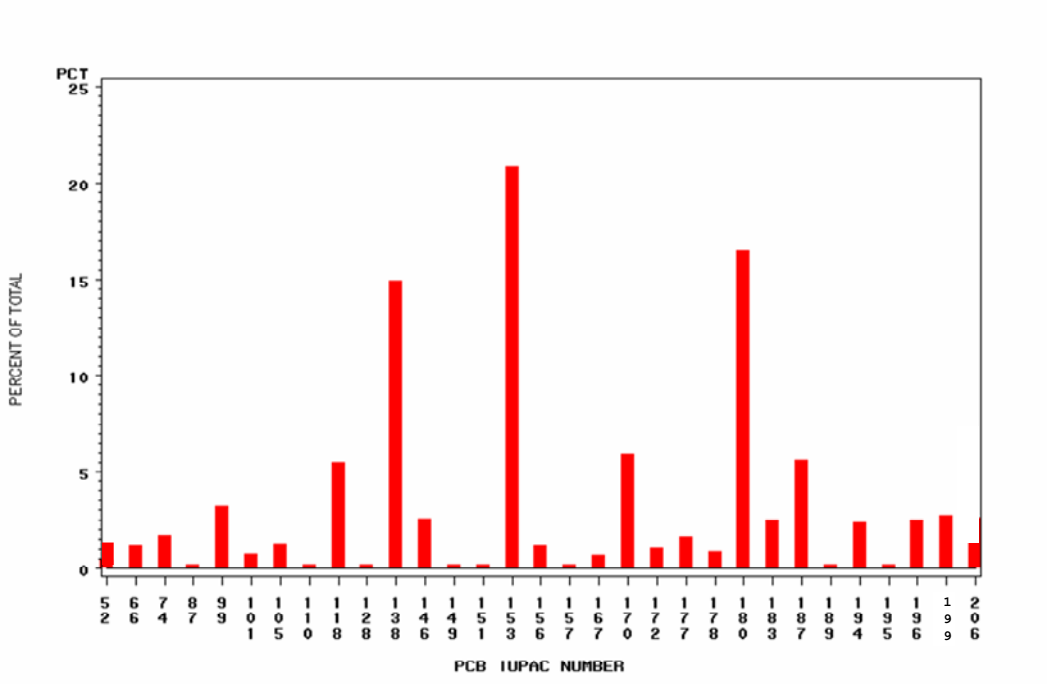


Figure 5

Typical PCB Pattern from NHANES 2001-2002 (Age 20+)



APPENDIX A: INDOOR ENVIRONMENTAL TESTING PROTOCOL

PROTOCOL FOR INDOOR ENVIRONMENTAL SAMPLING
ALLENDALE ELEMENTARY SCHOOL
PITTSFIELD, MASSACHUSETTS

Allendale Indoor PCB Environmental Sampling Workgroup

October 2006

INTRODUCTION

In order to address concerns about exposure opportunities to polychlorinated biphenyls (PCBs) at the Allendale Elementary School, the Allendale Indoor PCB Environmental Sampling Workgroup (workgroup) was formed. The workgroup is composed of representatives from the MA Department of Public Health's Center for Environmental Health Environmental Toxicology Program (MDPH/CEH/ETP); MA Department of Environmental Protection's Bureau of Waste Site Cleanup (MDEP); Pittsfield Board of Health; State University of New York at Albany's Institute for Health and the Environment (SUNY); Spectrum Analytical, Inc. (SAI); Southwest Research Institute (SWRI); Allendale Elementary School; the Housatonic River Initiative; and the Allendale School Task Force. The U.S. Environmental Protection Agency (USEPA) is attending meetings and providing technical assistance to the workgroup. MDEP has been informed and has discussed the sampling activities with CEH/ETP. The charge of the workgroup is to develop an indoor environmental sampling and analysis plan for this follow-up effort at the school.

GOAL

The overall goal of the proposed sampling effort is to determine whether PCBs are present in the indoor environment of the Allendale Elementary School in areas where children, faculty, and staff may have opportunities for exposure; and to determine if health concerns are present and whether follow-up activities are warranted.

OBJECTIVES

Specific objectives are to collect and analyze samples for PCBs utilizing both congener specific and Aroclor based standard methods. These samples will include: indoor air (with an outdoor comparison sample), surface wipes, carpet surface dust, vacuum bag dust, and unit ventilator filters. The sampling objectives will serve to address several questions, including the following:

1. Are detectable concentrations of PCBs present in the indoor environment of the school?
2. Are detectable concentrations of PCBs present in areas of the school accessible to students and staff?
3. If PCBs are present in the school, could the concentrations present exposure opportunities or health concerns?

LOCATION OF SAMPLES

Air Samples:

Location of Samples: Samples will be collected from inside the school in, or in the vicinity of classrooms #21 and 28 and outside the school in the building nook between classrooms #23 and 24 (see Figure).

Rationale: Classroom #21 is the middle classroom in the new building wing and #28 is the middle classroom in the original building, both of which face the back of the school and the GE disposal area. Thus, both classrooms are representative of the two wings of the building and are on the side of the school that faces the landfills. Classroom #28 has water damaged ceiling tiles, which could provide an entry point for unfiltered outside air (MDPH 2005). Wind coming from the direction of the GE disposal area will likely pool in the area where the two wings of the school meet, which is between classrooms #23 and 24. Sampling at this location would likely constitute the highest PCBs concentrations, if any, near the school.

Wipe Samples:

Location of Samples: Wipe samples will be taken to obtain a representative picture of possible concentrations of PCBs on frequently and infrequently touched hard surfaces inside the school. Samples will be collected from selected classrooms on the rear-side of the building, which faces the GE disposal site, as well as hallway corridors, the gymnasium, and several locations to be chosen on the day of sampling. In selected classrooms, samples will be collected from one windowsill and a wall on the opposite side of the classroom from the windows, representing frequently touched areas, and a window pane and the top shelf of a bookshelf, representing infrequently touched areas. The selected classrooms are #19, 24, 28, and 32. Four wipe samples will be collected from the two corridors that span the length of the two building wings. The wipe samples will be collected from one location on each side of the corridor, in each wing, above the area that is normally cleaned (approximately five feet). Wipe samples will be collected from the top of 1 or 2 hanging ceiling lights (depending on accessibility) that are located in the gymnasium. The hallway corridor and gymnasium samples represent infrequently touched surfaces (see Figure). Finally, several wipe samples will be collected from locations chosen during the sampling event.

Rationale: PCBs that could potentially enter the school through the air could potentially be bound to dust particles and settle onto surfaces. Therefore, collecting wipe samples from specific locations within the school will provide information on whether PCBs are present. Specific classrooms within the school were chosen based on information gathered during the MDPH/CEH site visit in November 2005 and contained in the MDPH/CEH Emergency Response/Indoor Air Quality Program's report, "Indoor Air Quality Assessment: Allendale Elementary School." All of the classrooms were chosen because they face the Hill 78 disposal area, they represent classrooms distributed along

the entire length of the building facing the Hill 78 disposal area, and they have water-stained ceiling tiles. The water stains could be from leaks in the roof, which are a potential route for outside air to enter the classroom without passing through the unit ventilator filters (MDPH 2005). Open classroom windows and doors, possibly during warmer months or to let children outside, are also routes for unfiltered air to enter the classrooms. The ceiling lights in the gymnasium represent an area that is likely infrequently touched, except for an occasional light bulb change. Some work group members expressed concern that dust from the lights could become airborne or fall to the gymnasium floor during times of building activity/vibration.

Unit Ventilator Filter Samples:

Location of Samples: Each unit ventilator has three filters which lie in a row parallel to each other (i.e., the air passes through this row of filters) (MDPH 2005). For consistency, samples of unit ventilator filters will be collected from the center filter in each unit ventilator. Samples will be collected from classrooms # 21 and 24 (see Figure). These classrooms face the back of the school and the Hill 78 disposal area.

Rationale: Each occupied classroom within the school is provided heat and outside air by a unit ventilator. The unit ventilators intake air from both outside and from inside the room, mix it, and then vent it into the room. During cooler months, the unit ventilator heats the air before venting it into the room. During warmer months, the unit ventilator provides a source of outside air. Before air is vented into the room, it passes through a filter, which is intended to capture dust particles. The unit ventilator filters capture dust particles before they enter the classroom as they draw air in from the outside and they also capture dust particles that are inside the classroom by recirculating classroom air. PCBs that have attached to dust particles may become trapped in the filters. The classrooms were chosen because they face the Hill 78 disposal area. Classroom #24 was specifically selected because it is located in the building nook, where the two wings of the school meet. It is theorized that wind blowing from the Hill 78 disposal area towards the school would pool in the nook due to the shape of the building.

Carpet Surface Dust Samples:

Location of Samples: Samples will be collected from classroom #19, a kindergarten room (see Figure).

Rationale:

1. Carpet can retain dust on its surface as individuals walk on it and airborne particles settle onto it.
2. Individuals can come into contact with this dust while touching or playing on the carpet.
3. The classroom faces the GE disposal area, and has a water damaged ceiling tile, which could provide an entry point for unfiltered outside air (MDPH 2005).

Vacuum Bag Sample:

Location of Sample: Dust samples will be collected from a vacuum cleaner that is operated throughout the entire school.

Rationale: Dust settles throughout the entire school. The vacuum cleaner collects dust that settles on the floor, along with any possible PCBs. Sampling the contents of the vacuum cleaner bag will provide information on whether PCBs are present in the floor dust.

TIMING OF SAMPLE COLLECTION

Description: Samples will be collected during the week of June 12, 2006 (see Sample Packaging and Transport/Chain of Custody section for information on sample possession). The vacuum cleaner bag sample will be collected after the vacuum cleaner has been used for one school week (i.e., 5 days). Carpet surface dust, wipe and unit ventilator filter samples will be collected during a single school day during that week. Air samples will begin to be collected during the same school day as carpet surface dust, wipe, and unit ventilator filters (the machines run for 24 hours). Air samples need to be collected during active operation of the landfills and on a warm dry weather day, preferably after a period of wet weather. Air samples will be collected during two distinct sampling rounds on two different days.

Rationale: PCBs can become airborne through a process of volatilization. This process can be increased when PCB-contaminated soil dries, as more PCBs enter the atmosphere (ASTDR 2000). The months of May and June typically involve periods of wet weather, followed by periods of dry, warm weather. Measurements of PCBs during this time period would likely be representative of the highest rates of PCB volatilization from Hill 78.

SAMPLE COLLECTION METHODS

Air Samples:

Description: All samples will be collected by a trained technician with Environmental Compliance Services (ECS), an environmental consulting firm. Samples will be collected by following USEPA Method TO-4A. This method involves using a high volume sampler, which is a box-like structure that contains a motor and a cartridge, to collect and filter air onto a sorbent cartridge for 24 hours. The cartridge is then placed into a sterile glass jar, which is placed in a cooler.

Rationale: USEPA Method TO-4A is the standard method for collecting and analyzing air samples for PCBs. One sample will be collected from each location for each of the two sampling rounds and split by SWRI after being extracted into a solution. Co-located samples cannot be collected due to the logistics of collecting the air samples (e.g., shipping the equipment, running several loud machines in classrooms during the school

day). The analytical methods require that the samples be cooled after collection and prior to analysis.

Wipe Samples:

Description: All samples will be collected by a trained technician with ECS. Wipe samples will be collected using a National Institute for Occupational Safety and Health (NIOSH) surface wipe method. This method involves wetting an absorbent pad with hexane, wiping a 10 centimeter x 10 centimeter area horizontally, vertically, horizontally again, and placing the pad in a sterile glass jar. Three co-located samples will be collected from each sample location (i.e., samples will be collected from an area adjacent to each other). The jars will be placed into a cooler.

Rationale: ECS technicians have been trained to collect environmental samples, including wipe samples. The SAI method ensures that any PCBs will become attached to the absorbent pad. This method is similar to a USEPA Collection method included in the Toxic Substances Control Act regulations (40 Code of Federal Regulations 761.123). In order to produce three samples from each sample location for the three laboratories to analyze, co-located samples will be collected. Three samples cannot be collected from the same location because the sample collection method is intended to remove all possible PCBs from the location after the first wipe.

Unit Ventilator Filter Samples:

Description: All samples will be collected by a trained technician with ECS. Samples will be collected by using the following method: using sterile gloves and a pair of scissors, a 1"x 10" section of the middle filter will be removed from three edges of the unit ventilator filter and placed into separate sterile glass jars. The scissors will be wiped with hexane between samples. The jars will be placed into a cooler.

Rationale: The unit ventilators contain three filters, which are installed with metal spaces that prevent air from bypassing the filters (MDPH 2005). Due to this design, the air should have an equal probability of passing through each of the filters. The middle filter and clippings from the three edges were chosen simply to be consistent. One clipping will be analyzed by each of the three laboratories. While there is no available USEPA sample collection method for unit ventilator filter samples, the analytical methods require that the samples be cooled after collection and prior to analysis.

Carpet Surface Dust Samples:

Description: All samples will be collected by a trained technician with ECS. The samples will be collected according to a method developed by the American Society for Testing and Materials International (ASTM) (i.e., ASTM D5438-00). The carpet will be divided into quadrants and a sample will be collected from three of the quadrants. The samples will be placed into a cooler.

Rationale: In order to produce three samples for the three laboratories to analyze, the carpet needs to be divided into sections. Three samples cannot be collected from the same location on the carpet because the sample collection method is intended to remove all possible surface dust after the first vacuuming. The analytical methods require that the samples be cooled after collection and prior to analysis.

Vacuum Bag Sample:

Description: The school vacuum cleaner will be operated in a normal fashion by the custodian. At the end of the week, the vacuum bag will be removed from the vacuum, placed into a cooler, and sent overnight delivery to SWRI, where the dust will be separated for the three laboratories, according to the previously agreed upon SOPs.

Rationale: The custodian vacuums the school daily. The purpose of sampling the vacuum cleaner bag is to determine the levels of PCBs that may be present in the dust throughout the school. ECS staff will retain chain of custody of the vacuum at all times during the test week.

SAMPLE PACKAGING AND TRANSPORT/CHAIN OF CUSTODY

Description: ECS staff will maintain possession of the samples during and after collection. ECS will maintain possession of the school's vacuum cleaner when it is not in use and will be present when it is in use. Depending upon the time when sampling is completed, the samples may be stored in a refrigerator at ECS in Agawam (i.e., if the sampling is completed after the closing of mail facilities). ECS will package the samples into coolers and overnight deliver them to SWRI in San Antonio, Texas and SUNY in Albany, New York and deliver them to SAI in Agawam, Massachusetts. SWRI will receive carpet surface dust, vacuum bag dust, wipe, unit ventilator filter, and air samples. SAI and SUNY will receive carpet surface dust, wipe, and unit ventilator filter samples. SWRI will process the air and vacuum bag dust samples in order to extract any PCBs into a solution, which will be split into four aliquots. SWRI will ship an aliquot to SAI and SUNY, analyze one aliquot, and hold onto an aliquot for QA/QC purposes (e.g., in case an aliquot is lost during shipping).

Rationale: For chain of custody purposes, it is important that ECS and the respective laboratories maintain possession of the samples during and after sample collection. The analytical methods require that the samples be cooled after collection and prior to analysis.

SAMPLE ANALYSIS METHODS

All laboratories must follow detailed standard operation procedures (SOPs) that are agreed to prior to the start of sampling.

Description: Following their SOPs for sample preparation for PCB analysis, SWRI, SAI, and SUNY will first process the samples into a solution in order to extract any PCBs.

Air and Vacuum Cleaner Bag Dust: SWRI will be analyzing air and vacuum cleaner bag dust samples for both particle-phase and vapor-phase PCB Aroclors and congeners using a modified USEPA Method TO-4A. SWRI will be analyzing vacuum cleaner bag dust samples for both PCB Aroclors and congeners using USEPA Method TO-4A. SAI will be analyzing air and vacuum cleaner bag dust samples for PCB Aroclors using USEPA Method TO-4A. SUNY will be analyzing air and vacuum cleaner bag dust samples for PCB congeners using a method based on two published research papers: DeCaprio et al. 2000, 2005.

Carpet Surface Dust, Wipes and Unit Ventilator Filters: SWRI will be analyzing carpet surface dust, wipe, and unit ventilator filter samples for PCB Aroclors and congeners using a modification of USEPA Method TO-4A. SAI will be analyzing carpet surface dust, wipe, and unit ventilator filter samples for PCB Aroclors using USEPA Method SW846: 8082. SUNY will be analyzing carpet surface dust, wipe, and unit ventilator filter samples for PCB congeners using a method based on two published research papers: DiCaprio et al. 2000, 2005.

Rationale: Three different laboratories (i.e., Spectrum Analytical Laboratory, SUNY Institute for Health and Environment Laboratory, and Southwest Research Institute) will be analyzing samples in order to address questions raised about previous testing that analyzed separate samples from the school for Aroclors and congeners and reported different results. USEPA Method SW846: 8082, 1668A, and TO-4A are certified by the USEPA. USEPA Method SW846: 8082 uses gas chromatography/mass spectrometry to detect PCBs, USEPA Method TO-4A uses gas chromatography/multi-detector detection, and the modified USEPA Method TO-4A uses gas chromatography/mass spectrometry. SUNY bases their method from two published research papers, which describe the method for congener analysis in detail. This method uses parallel dual-column gas chromatography with electron capture detection.

ANALYTES

Aroclors: Aroclor is the industrial trade name for commercially produced mixtures of PCBs used in the manufacturing of electrical equipment at GE. The mixtures consist of varying amounts of chlorine, which are signified by the last two digits of their names. For example, Aroclor 1254 contains approximately 54% chlorine by weight, while Aroclor 1260 contains approximately 60% chlorine by weight. The exception is Aroclor 1016, which contains approximately 41% chlorine by weight (ATSDR 2000).

The samples will be analyzed for seven specific Aroclor mixtures: 1016, 1221, 1232, 1242, 1248, 1254, and 1260. These are the Aroclors that the USEPA Method SW846: 8082 has been tested for (USEPA 1996).

Congeners: Congeners are single, unique compounds within PCBs (ASTDR 2000). While there are a total of 209 different congeners, most are not commonly detected (McFarland and Clarke 1989). Based on a review of published literature on congeners

detected in house dust and indoor air (e.g., Currado and Harrad 1998; Kohler et al. 2002; MacLeod 1981; Vorhees et al. 1997, 1999; Wallace et al. 1996; Wilson et al. 2001) their percent makeup in the above listed Aroclors (Camann et al. 2002; Camann et al. 2001; Levin et al. 2002; Rudel et al. 2003; Wolff et al. 1997), and the congeners that were previously analyzed for by SUNY, the samples will be analyzed for 101 specific congeners: #1, 3, 4+2, 10, 7, 9, 6, 8, 19, 13, 18, 15, 17, 24+27, 32+16, 29, 26, 25, 31, 28, 33, 53, 51, 22, 45, 46, 52, 49, 47+59, 44, 42, 71, 64, 40, 67, 63, 74, 70, 66, 95, 91, 56, 92, 84, 90+101, 99, 83, 97, 87, 85, 136, 110, 77, 151, 144, 147+109, 123+149, 118, 134, 114, 146, 153, 132, 105, 141, 179, 137, 176, 130, 164+163+138, 158, 129, 187, 183, 128, 185, 174, 177, 171, 156, 201, 172, 180, 200, 170, 190, 199, 203, 196, 195, 194, 206. This list of PCB congeners includes the 18 PCB congeners which comprise at least 5% by weight of several Aroclor mixtures; many of them are prevalent in several of the Aroclor mixtures (ATSDR 2000, Camann 2006). This congener list also represents the full range of lower to higher chlorinated congeners.

QA/QC PROCEDURES

Laboratory Control Sample: The accuracy of the laboratory analysis will be checked by having the laboratories analyze spiked sample media. An unused media for each sample type (i.e., cotton wipe, unit ventilator filter, and air cartridge filter) will be shipped to each laboratory. The laboratories will spike the media with a known PCB Aroclor or congener and then analyze the sample for it. This will provide percent recovery.

Matrix Duplicate: An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.

Method Blanks: Sample contamination resulting from the laboratory analytical methods will be checked by method blanks. Method blanks consist of an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank will be carried through the complete sample preparation and analytical procedure.

Standard Reference Materials®: The comparability of the congener laboratory results will be checked by having SWRI and SUNY analyze standard reference materials® (SRMs). SRMs are produced by the National Institute of Standards and Technology (NIST) and are certified to contain a specific amount of a substance. SRMs for Aroclor analysis are no longer produced. The congener SRMs will help in comparing data from SWRI and SUNY.

Surrogates: A surrogate is an organic compound that is similar to the target analyte (i.e., PCBs) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.

Trip Blanks: Field sampling methods will be checked by collecting a trip blank using pre-cleaned sample containers provided by ECS. Trip blanks are used to assess field introduced PCB contamination into samples. Air and wipe trip blanks will comprise the

sampling media placed in the sample container. Unit ventilator filter trip blanks will be comprised of clippings from new unit ventilator filters placed in the sample container. Trip blanks will be packaged at the school, like the regular samples, to capture any field-introduced PCBs. Trip blanks for each medium will be collected and analyzed by each laboratory.

DATA EVALUATION

The data will be evaluated by the CEH/ETP using methodologies consistent with readily available guidance or methods, and consistent with evaluations contained in the public health assessments produced by MDPH (MDPH 2003a-h).

Air Samples

Description: The air samples will be evaluated by using health-based screening values, such as the CREG, that have been scientifically peer reviewed or derived using scientifically peer reviewed values and published by ATSDR. If a concentration of PCB exceeds its screening value, adverse health effects are not necessarily expected. Rather, the concentration can be further evaluated for the specific situation (e.g., outdoor sample, classroom sample) to determine whether health effects might be possible. In addition to screening, the results from the air samples will also be used to calculate a lifetime average daily intake, which takes into account certain assumptions, such as the age specific average weight of the person, air intake rate [e.g., 10 cubic meters per day (m^3/day) for child, 15.2 m^3/day for adult], and the length of time in the building (e.g., 6 hours/day for 180 days/year for child, 8 hours/day for 180 days/year for adult). ATSDR has not developed an MRL for inhalation because of a lack of sufficient data on which to base an MRL. In lieu of this, the air results will be compared to the lowest level that adverse health effects (LOAEL) have been observed in animal studies (LOAEL = 3 $\mu g/m^3$) for evaluating the risk of adverse noncancer health effects. The air sample results will also be compared to background values reported in previously published studies that evaluated PCB concentrations in air (e.g., ATSDR 2000, Vorhees et al. 1997).

Rationale: MDPH/CEH/ETP traditionally uses both quantitative and qualitative approaches to evaluating results. Examples of this can be seen in the Discussion sections of the public health assessments MDPH/CEH/ETP has written for the GE sites. These can be found on the MDPH website (www.mass.gov/dph/ceh), at the Berkshire Atheneum, or by calling MDPH to request a copy (617-624-5757).

Carpet Surface Dust, Vacuum Cleaner Bag Dust, and Wipe Samples

Description: Carpet surface dust, vacuum cleaner bag dust, and wipe samples measure the possible concentration of PCBs in the dust and residue on a specific surface. Individuals (e.g., students, staff) that come into contact with PCBs that are in the dust and residue could potentially ingest them or the PCBs could be absorbed through their skin. The results from these samples will be used to calculate a lifetime average daily intake,

which takes into account certain assumptions, such as the average weight of children and adults (e.g., 35 kilograms for child, 70 kilograms for adult), the amount of total soil adhered [e.g., 525 milligram per day (mg/day) for child, 326 mg/day for adult], and the length of time in the building (e.g., 6 hours/day for 180 days/year for child, 8 hours/day for 180 days/year for adult). The lifetime average daily intake can be compared to standard comparison or screening values such as the ATSDR Minimum Risk Level (MRL), which is 0.00002 milligrams per kilogram per day [milligram per kilogram per day (mg/kg/day)] for chronic oral exposure. The MRL is an estimate of daily human exposure to a substance (e.g., PCBs) that is likely to be without an appreciable risk of adverse noncancer health effects over a specified duration of exposure. MRLs are derived from no-observed-adverse-effect-levels (NOAELs) or lowest-observed-adverse-effect-levels (LOAELs) from either human or animal studies. For cancer effects, estimated intake can be compared to Cancer Risk Evaluation Guides (CREGs). CREGs are derived assuming a lifetime of exposure in a residential setting. While there is not a CREG for the ingestion of PCBs in dust, there is a CREG of 0.4 mg/kg for the ingestion of PCBs in soil. These comparison values are intended to be used as guidance. It is also important to emphasize that exposures to children should be prevented or minimized to the extent possible.

With regard to skin contact with PCB dust from surfaces, the Exposure Factors Handbook has summarized literature for children on this topic (USEPA 1997). In general, the major factors that affect opportunities for exposure via skin contact (e.g., PCBs from surface wipe samples from indoor environments) are: how much PCB is in contact with the skin; the potential amount taken in by ingestion or skin absorption the amount of skin surface area exposed; and the duration of exposure. It is important to note that not all of the compounds (e.g., PCBs) found in a layer of dust/dirt on the skin surface may be taken into the body by ingestion or skin absorption. However, in many cases assumptions can be made to estimate what the upper limit of ingestion/absorption may be so as to know whether there is a reason to be concerned about health impacts. We know that a number of factors influence how much dust/dirt adheres to skin. Increased dust/dirt moisture levels, hand contact, and outdoor activities, particularly with wet soil contact (e.g., wetlands, riverbanks) will lead to greater dust/dirt adherence to skin. The wipe sample results will also be compared to values reported in previously published studies that evaluated PCB concentrations in dust (e.g., ATSDR 2000, Vorhees et al. 1999).

Rationale: There is little information available on federal or state guidelines or standards for evaluating PCB carpet surface dust, vacuum cleaner bag dust, or wipe sample results for human health purposes. The only formal guidelines that were found were a USEPA clean-up standard of 10 micrograms PCB per 100 square centimeters (10 μg/100 cm^2) for wipes collected from indoor residential surfaces that have been affected by a spill of a low-concentration PCB mixture (40 Code of Federal Regulations 761.125) and a recommended clean-up standard of 0.1 μg/100 cm^2 developed by the California Department of Toxic Substance Control for PCB contamination in schools resulting from lighting retrofits (CDTSC 2003). Exposure will be estimated and compared to the MRL, NOAELs, and LOAELs. We will approach the interpretation of these samples utilizing a

standard approach as described in the equation in the Exposure Factors Handbook (see Attachment) and guidance for ATSDR public health assessments.

Unit Ventilator Filter Samples

Description: The unit ventilator filter samples will be qualitatively evaluated by reviewing information on all other sample results and such factors as weather, location, etc. and by qualitatively comparing these results to indoor classroom results.

Rationale: There are no available federal or state guidelines or standards for evaluating PCB unit ventilator filter sample results for human health purposes. The unit ventilators are designed to transport outside air into the classroom, filter it, and to re-circulate the air once it is inside. As such, they can capture particulates with PCBs and hence provide a qualitative indicator of the presence of PCBs in fugitive dust. However, there is no direct exposure to the filters themselves (not accessible except occasionally to maintenance staff). For that reason, measurements in carpet surface dust, wipe, vacuum cleaner bag dust, and air samples are more important in evaluating exposure risks because individuals can come into contact with PCBs in those media. Results from unit ventilator filter samples may provide an understanding of potential exposure opportunities from particulate matter containing PCBs over extended periods of time.

REFERENCES

ATSDR. 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry.

Camann, David E. 2006. Correspondence to Michael Celona, Senior Environmental Analyst, Department of Public Health, Center for Environmental Health from David E. Camann, Staff Scientist, Southwest Research Institute. March 13, 2006.

Camann, DE., JS Colt, and MM Zuniga. 2002. Distributions and quality of pesticide, PAH, and PCB measurements in bag dust from four areas of USA. *Proceedings: Indoor Air 2002*. pp: 860-864.

Camann, David E., Susan L. Teitelbaum, and Marilie D. Gammon. 2001. Distributions and quality of pesticide, PAH, and PCB measurements in Long Island carpet dust. International Society of Exposure Analysis Annual Meeting. Charleston, SC. Abstract 360.

CDTSC. 2003. PCB Advisory for Schools: How Voluntary Lighting Retrofits Can Address Hidden Dangers. California Department of Toxic Substances Control. June 2003.

Currado, Gian Marco and Stuart Harrad. 1998. Comparison of Polychlorinated Biphenyl Concentrations in Indoor and Outdoor Air and the Potential Significance of Inhalation as a Human Exposure Pathway. *Environmental Science & Technology*. Volume 32: pp. 3043-3047.

DeCaprio, Anthony P., Glenn W. Johnson, Alice M. Tarbell, David O. Carpenter, Jeffrey R. Chiarenzelli, Gayle S. Morse, Azara L. Santiago-Rivera, Maria J. Schymura, and Akwesasne Task Force on the Environment. 2005. Polychlorinated biphenyl (PCB) exposure assessment by multivariate statistical analysis of serum congener profiles in an adult Native American population. *Environmental Research*. Volume 98: pp 284-302.

DeCaprio, Anthony P., Alice M. Tarbell, Amelie Bott, Dana L. Wagemaker, Randy L. Williams, and Colleen M. O'Hehir. 2000. Routine analysis of 101 polychlorinated biphenyl congeners in human serum by parallel dual-column gas chromatography with electron capture detection. *Journal of Analytical Toxicology*. Volume 24: pp 403-420.

Frame, GM., JW Cochran, and SS Boewadt. 1996. Complete PCB congener distributions for 17 Aroclor mixtures determined by 3 HRGC systems optimized for comprehensive, quanititative, congener-specific analysis. *Journal of High Resolution Chromatography*. Volume 19: pp: 657-668.

Kohler, M., M. Zennegg, and R. Waeber. 2002. Coplanar Polychlorinated Biphenyls (PCBs) in Indoor Air. *Environmental Science & Technology*. Volume 36: pp. 4735-4740.

MacLeod, Kathryn E. 1981. Polychlorinated Biphenyls in Indoor Air. *Environmental Science & Technology*. Volume 15, Number 8: pp. 926-928.

McFarland, V.A. and J.U. Clarke. 1989. Environmental occurrence, abundance, and potential toxicity of polychlorinated biphenyl congeners: Considerations for a congener-specific analysis. *Environmental Health Perspectives*. Volume 81: pp. 225-239.

MDPH. 2003a. Public Health Assessment for General Electric Site- East Street Area 1. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003b. Public Health Assessment for General Electric Site- East Street Area 2. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003c. Public Health Assessment for General Electric Site- Former Oxbows. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003d. Public Health Assessment for General Electric Site- Hill 78 Area. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003e. Public Health Assessment for General Electric Site- Lyman Street. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003f. Public Health Assessment for General Electric Site- Newell Street Area 1. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003g. Public Health Assessment for General Electric Site- Newell Street Area 2. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2003h. Public Health Assessment for General Electric Site- Unkamet Brook. Massachusetts Department of Public Health, Center for Environmental Health. September 30, 2003.

MDPH. 2005. Indoor Air Quality Assessment: Allendale Elementary School. Massachusetts Department of Public Health, Center for Environmental Health, Emergency Response/Indoor Air Quality Program.

Rudell, Ruthann A., David E. Camann, John D. Spengler, Leo R. Korn, and Julia G. Brody. 2003. Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and

other endocrine-disrupting compounds in indoor air and dust. *Environmental Science & Technology.* Volume 37, Number 20: pp: 4543-4553.

USEPA. 2003. USEPA Method 1668, Revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS, with changes and corrections through to August 20, 2003.

USEPA. 1997. USEPA Exposure Factors Handbook.

USEPA. 1996. SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 8082: Polychlorinated Biphenyls (PCBs) by Gas Chromatography. U.S. Environmental Protection Agency. Revision 0, December 1996.

Vorhees, Donna J., Alison C. Cullen, and Larisa M. Altshul. 1999. Polychlorinated biphenyls in house dust and yard soil near a Superfund site. *Environmental Science & Technology*. Volume 33, Number 13: pp. 2151-2156.

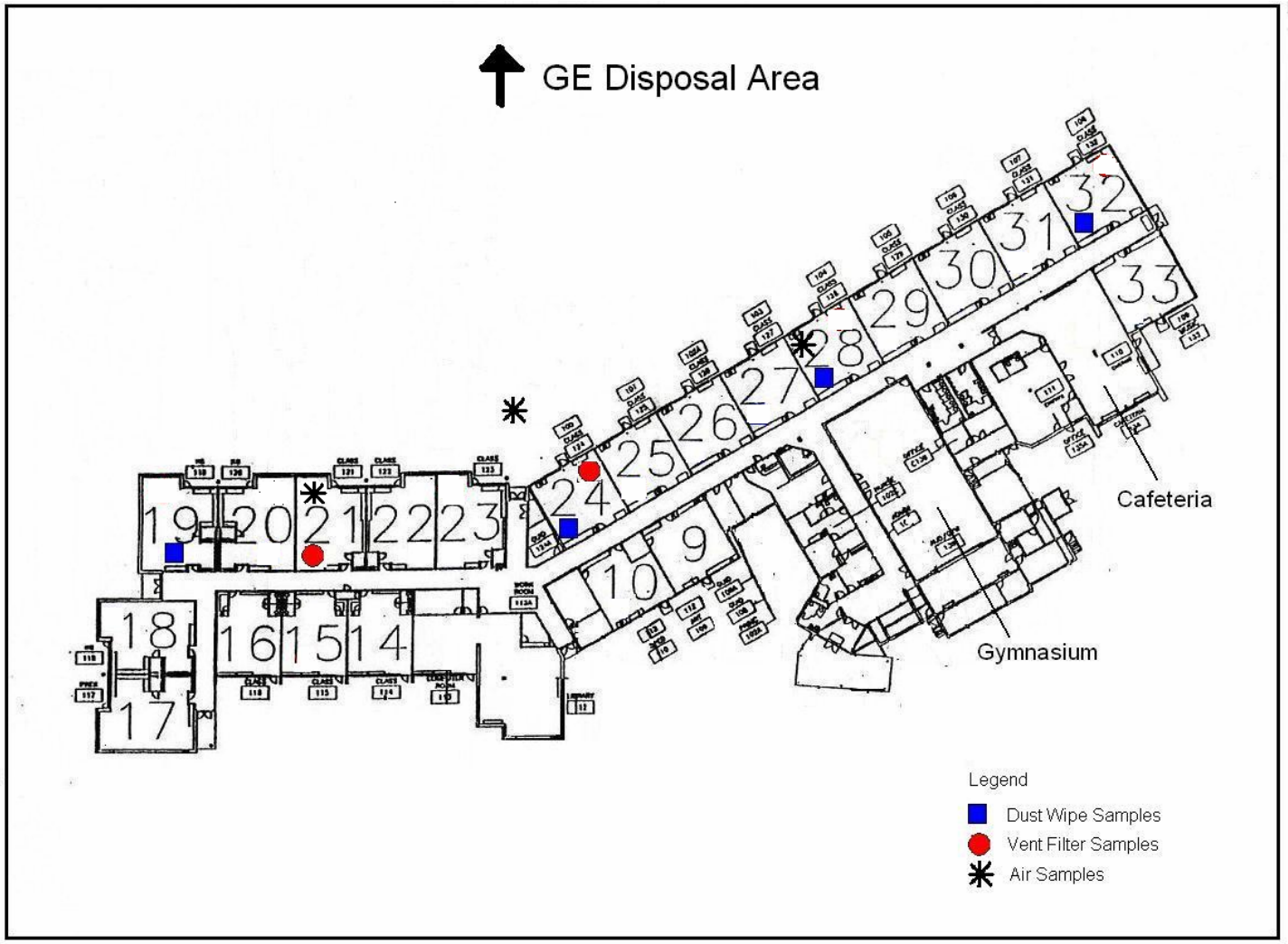
Vorhees, Donna J., Cullen A. C., Altshul, L.M. 1997. Exposure to polychlorinated biphenyls in residential indoor air and outdoor air near a Superfund site. *Environmental Science & Technology.* Volume 31, Number 12: pp. 3612-3618.

Wallace, Jeffery C., Ilora Basu, and Ronald A. Hites. 1996. Sampling and analysis artifacts caused by elevated indoor air polychlorinated biphenyl concentrations. *Environmental Science & Technology*. Volume 31, Number 12: pp. 3612-3618.

Wilson, Nancy K., Jane C. Chuang, and Christopher Lyu. 2001. Levels of persistent organic pollutants in several child day care centers. *Journal of Exposure Analysis and Environmental Epidemiology.* Volume 11, Issue 6: pp. 449-458.

Wolff, MS., D. Camann, M. Gammon, and SD Stellman. 1997. Proposed PCB congener groupings for epidemiological studies. *Environmental Health Perspectives*. Volume 105, Issue 1: p:13.

FIGURE


GE Disposal Area
Cafeteria
Gymnasium
Legend
Dust Wipe Samples
Vent Filter Samples
Air Samples

ATTACHMENT

6. DERMAL ROUTE

Dermal exposure can occur during a variety of activities in different environmental media and microenvironments (U.S. EPA, 1992). These include:

- Water (e.g., bathing, washing, swimming);
- Soil (e.g., outdoor recreation, gardening, construction);
- Sediment (e.g., wading, fishing);
- Liquids (e.g., use of commercial products);
- Vapors/fumes (e.g., use of commercial products); and
- Indoors (e.g., carpets, floors, countertops).

The major factors that must be considered when estimating dermal exposure are: the chemical concentration in contact with the skin, the potential dose, the extent of skin surface area exposed, the duration of exposure, the absorption of the chemical through the skin, the internal dose, and the amount of chemical that can be delivered to a target organ (i.e., biologically effective dose) (see Figure 6-1). A detailed discussion of these factors can be found in Guidelines for Exposure Assessment (U.S. EPA, 1992a).

This chapter focuses on measurements of body surface areas and various factors needed to estimate dermal exposure to chemicals in water and soil. Information concerning dermal exposure to pollutants in indoor environments is limited. Useful information concerning estimates of body surface area can be found in "Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessments" (U.S. EPA, 1985). "Dermal Exposure Assessment: Principles and Applications (U.S. EPA, 1992b), provides detailed information concerning dermal exposure using a stepwise guide in the exposure assessment process.

The available studies have been classified as either key or relevant based on their applicability to exposure assessment needs and are summarized in this chapter. Recommended values are based on the results of the key studies. Relevant studies are presented to provide an added perspective on the state-of-knowledge pertaining to dermal exposure factors. All tables and figures presenting data from these studies are shown at the end of this chapter.

6.1. EQUATION FOR DERMAL DOSE

The average daily dose (ADD) is the dose rate averaged over a pathway-specific period of exposure expressed as a daily dose on a per-unit-body-weight basis. The ADD is used for exposure to chemicals with non-carcinogenic non-chronic effects. For

compounds with carcinogenic or chronic effects, the lifetime average daily dose (LADD) is used. The LADD is the dose rate averaged over a lifetime.

For dermal contact with chemicals in soil or water, dermally absorbed average daily dose can be estimated by (U.S. EPA, 1992b):

$$ADD = \frac{DA_{event} \times EV \times ED \times EF \times SA}{BW \times AT} \qquad \text{(Eqn. 6-1)}$$

where:

ADD	=	average daily dose (mg/kg-day);
DA_{event}	=	absorbed dose per event (mg/cm^2-event);
EV	=	event frequency (events/day);
ED	=	exposure duration (years);
EF	=	exposure frequency (days/year);
SA	=	skin surface area available for contact (cm^2);
BW	=	body weight (kg); and
AT	=	averaging time (days) for noncarcinogenic effects, AT = ED and for carcinogenic effects, AT = 70 years or 25,550 days.

This method is to be used to calculate the absorbed dose of a chemical. Total body surface area (SA) is assumed to be exposed for a period of time (ED).

For dermal contact with water, the DA_{event} is estimated with consideration for the permeability coefficient from water, the chemical concentration in water, and the event duration. The approach to estimate DA_{event} is different for inorganic and organic compounds. The nonsteady-state approach to estimate the dermally absorbed dose from water is recommended as the preferred approach for organics which exhibit octanol-water partitioning (U.S. EPA, 1992b). First, this approach more accurately reflects normal human exposure conditions since the short contact times associated with bathing and swimming generally mean that steady state will not occur. Second, the approach accounts for uptake that can occur after the actual exposure event due to absorption of residual chemical trapped in skin tissue. Use of the nonsteady-state model for organics has implications for selecting permeability coefficient (K_p) values (U.S. EPA, 1992b). It is recommended that the traditional steady-state approach be applied to inorganics (U.S. EPA, 1992b). Detailed information concerning how to estimate absorbed dose per event (DA_{event}) and K_p values can be found in Section 5.3.1 of "Dermal Exposure Assessment: Principles and Applications" (U.S. EPA, 1992b).

For dermal contact with contaminated soil, estimation of the DA_{event} is different from the estimation for dermal contact with chemicals in water. It is based on the concentration of the chemical in soil, the adherence factor of soil to skin, and the absorption fraction. Information for DA_{event} estimation from soil contact can be found in U.S. EPA (1992b), Section 6.4.

APPENDIX B: SUMMARY PROTOCOL FOR TESTING SERUM PCB

PROJECT SUMMARY AND ENCLOSURES

Introduction/Background

The primary purpose of this document is to provide the protocol/rationale for interpreting serum PCB results of faculty/staff and students who attend the Allendale School in Pittsfield. PCB serum testing of students, parents, faculty and staff of the Allendale School is being offered as a service to the Allendale School community in response to public concerns related to the General Electric (GE) disposal site (i.e. Hill 78 and Building 71) located in an area adjacent to the school.

The disposal site receives PCB waste materials from the clean-up of the GE sites in Pittsfield. The Massachusetts Department of Public Health, Center for Environmental Health (MDPH/CEH) has completed eight public health assessments for the GE sites (the public health assessment for Hill 78 Landfill Area conducted by the MDPH/CEH is enclosed for your information). The remedial work being carried out by GE contractors is under the oversight of the U.S. Environmental Protection Agency (EPA) under a Consent Decree agreed to by EPA, the Massachusetts Department of Environmental Protection (MDEP), the City of Pittsfield, and GE in 2001. The disposal site consists of two landfills, one lined landfill (i.e. Building 71 area) for higher level waste (e.g. PCB materials over 50 ppm, liquid wastes), and one landfill that is not lined (i.e. Hill 78 Landfill Area) for lower level waste (i.e. PCBs equal to or less than 50 ppm). Hill 78 Landfill Area was preexisting and historically received PCB waste materials at concentrations higher than the current 50ppm limit and other hazardous wastes. Systematic field sampling is done to determine the level of contamination. The remediation activities began around 2000. According to EPA the Building 71 Landfill is expected to reach full capacity this year (2006) and to have its final cap installed by 2007. EPA expects the Hill 78 Landfill to reach capacity in 2008 and have its final cap installed by 2009. Disposal activities occur during times of the year when the ground is not frozen (e.g. March/April through November/December). There are specific work practices and monitoring requirements in place under the Consent Decree. EPA has recently enhanced these monitoring efforts.

Monitoring results (i.e. ambient air monitoring including a new air monitor at Allendale School) conducted along the perimeter of the disposal site have averaged non-detectable or below health risk based criteria established by EPA. Soil sampling on the school playground and in the crawlspace under the school was also conducted by EPA and DEP in the fall of 2005. Results were non-detectable or have averaged below health risk based criteria established by EPA or MDEP.

In November/December 2005, MDPH/CEH hired independent contractors and sampled indoor air (and one outdoor air for background comparison), surface dust wipes, and air vent filter samples (103 total samples) in response to concerns related to the potential for site contaminants to enter the indoor environment. All samples were non-detectable for PCBs.

Concurrent with these indoor environmental tests, a local advocacy group also collected two filter samples from the Allendale School and they were found to have low levels of PCBs based upon congener analyses. MDPH/CEH, in collaboration with a work group, is designing

and implementing follow-up indoor environmental monitoring for June 2006, a time of year when the weather is warmer and the disposal site is active.

Serum PCB Testing

With regard to implementation of serum PCB testing, Berkshire Medical Center (BMC) will be providing phlebotomy services. BMC has provided these types of services for a number of MDPH projects in Berkshire County involving serum PCB measurements since 1995. Training on the proper collection, preparation, and shipping of blood samples will be provided to the BMC staff by MDPH State Laboratory Institute (MDPH/SLI) staff. The U. S. Centers for Disease Control and Prevention (CDC) in Atlanta has agreed to perform all analyses using a congener specific method as published in the Third National Report on Human Exposure to Environmental Chemicals in July 2005 (we have enclosed the summary and PCB chapters of this report for your information). The CDC has informed us that they are ready to begin receiving samples for analyses in May 2006.

The Third National Report presents biomonitoring exposure data for 116 environmental chemicals including PCBs for the civilian non-institutionalized U. S. population over the period 2001-2002 and is a nationally representative survey. The serum collection procedures were supplied by the CDC laboratory. Copies of the Blood Collection for Serum PCBs (supplies, procedures, flow chart for the phlebotomists), the CDC Method Summary, and the CDC Laboratory Procedure Manual for PCBs and Persistent Pesticides are enclosed. Analysis at CDC will be performed by high-resolution gas chromatography/isotope dilution high-resolution mass spectrometry (HRGC/ID-HRMS). Thirty-eight PCB congeners will be quantified according to the current CDC procedure that is being implemented for the Fourth National Report. Hence, the samples will be analyzed by state-of-the-art instrumentation and methodologies.

With regard to obtaining consent and important supplementary information to aid in the interpretation of results, we have enclosed copies of two consent forms, one to be signed by a parent for their child; the other to be signed by adult participants. These consent forms have been adapted from similar consent forms we have previously used for participants in PCB blood testing in Berkshire County and elsewhere in Massachusetts and that have been reviewed and approved by our Institutional Review Board (IRB). This version of the updated consent form was also recently approved by the MDPH Office of General Counsel.

With regard to obtaining supplementary (exposure) information, MDPH/CEH traditionally uses a standard questionnaire for obtaining information on risk factors that are known to or may affect serum PCBs levels. The two questionnaires (adult, child) will include questions on the following: age, gender, residential history (including duration of residence), usual occupation, occupation associated with use of PCBs, company, duration, number of years attending or working at Allendale School, locations in the school where most time was spent for up to each of the last seven school years (if applicable), time spent indoors and outdoors during the school day, fish consumption in general, freshwater fish consumption (how obtained, source, Housatonic River fish), change in fishing/fish consumption habits, fiddlehead fern gathering/consumption, recreational areas and types of activities in Pittsfield area (camping, playgrounds, dirt biking, etc), hunting/wildlife consumption (type of prey, how often), gardening (type), playing in dirt or grass at current address, farm residence, open ended question on any other contact with PCBs, breast feeding and duration (for child participant), number of prior

children breast fed (for adult female parent), lifestyle risk factors (e.g., smoking). The questionnaires will be administered in two parts; the more lengthy first part with be administered over the phone before the blood draw and the second part will be administered at the time of the blood draw. The second part of the questionnaire includes questions relevant to the blood draw (i.e. weight and height) as well as questions which will require the participant to view a map of the Allendale School.

Interpretation of Serum PCB Analyses

With regard to the interpretation of results, an important observation that has been made by public health researchers including MDPH/CEH is that serum PCB levels generally increase with age. Younger people have very low to (in many cases) non-detectable levels. The enclosures related to the PCB testing from the Third National Report clearly support this trend. Adult participants will be compared to their respective age/race group in the Third National Report. The considerable background information provided in the questionnaires for each participant will aid in understanding both individual and group results.

With regard to children under the age of 12, the older children in this age group would be expected to be similar to the 12 to 19 year olds included in the Third National Report. Younger participants would be expected to demonstrate lower serum PCB results (possibly non-detectable), but the responses to the questionnaire (e.g., dietary exposure, history of breast feeding) will provide important supplemental information. Research on the world literature to identify other groups of children who have been tested for PCBs is enclosed. While interesting, a number of these populations are confounded by industrial exposure, accidental poisoning, known high fish or blubber consumption, and other environmental sources of PCB exposure. The enrollment date into some studies is very long ago (e.g., 1960s, 1970s, 1980s) and CDC has told us that levels have dropped considerably, perhaps up to 80% since the 1980s. Thus, many of these cohorts are not necessarily optimal in establishing background levels today. The Dutch and German studies have more recent recruitment and provide information for younger children. The Faroese children (and mothers) are heavy consumers of blubber and fish so their levels would be expected to be higher. The Anniston, Alabama, study is interesting because it is very recent, there are young children included, and the laboratory methods are identical to those being used for the Allendale School community.

Laboratory methodology is important in measuring concentrations. Detection limits and quantification of varying numbers of congeners differ across studies (e.g., the Dutch studies use 4 congeners). Because children are normally so low, many researchers like to use the known higher more persistent congeners (e.g., PCB-153) as they are more reliably detected and measured in young children. When comparing studies with different congeners with regard to levels in the population, some researchers have picked one common congener (e.g., PCB-153) that is known to be usually the highest, while others choose all of the congeners that the studies being compared have in common to determine which study population has “higher” levels. We prefer the latter approach. Thus, in the approach to interpreting results from the Allendale School children participants, we will first determine which congeners were detected in the Allendale children that were common with any comparison study (e.g., the Third National Report, the Anniston study). We will then sum the concentrations of the congeners common to both the Allendale children and the comparison study to determine whether the Allendale children were higher or lower than the comparison study. Finally, we will qualitatively compare congener

patterns from the chromatograms to observe any patterns in the Allendale participants that may be different from the patterns CDC typically observes based on general dietary exposure in the U.S.

As noted earlier, each participant will be evaluated on a case by case basis. MDPH/CEH will work closely with CDC to interpret any findings (particularly as it relates to the child participants). MDPH/CEH in collaboration with CDC will decide whether either individual or group findings need further follow-up investigation based on review of all of the information.

Health and Medical Peer Review Team (MDPH/HMPRT):
Summary of responses to comments for documents relating to PCB blood testing for the Allendale School.

Comments from HMPRT Member 1:

1. **Comment:**
   Methodology- Would like clarification, difficulty determining minimal detection limits (or Limits of Detection-LOD) in information provided.
   - LOD vary for different congeners
   - Units vary from lab to lab
   - Based on attached articles: Detection limits must be pretty low- at least in the .01-.04 ppb (whole weight basis) to detect various congeners.

   Response:
   The published analyses from the Centers for Disease Control and Prevention (CDC) Third National Report on Human Exposure to Environmental Chemicals (NHANES III, July 2005) have congener specific LOD's. There are also individual LOD's for each sample, largely due to the sample volume available for analysis being different for each sample. A higher sample volume results in a lower LOD and a better ability to detect low levels, as stated in NHANES III, appendix A. The CDC is conducting the analysis for the serum samples from the Allendale School Community using the most up to date congener specific methods that they use for the ongoing NHANES sampling; therefore there will be no lab to lab unit discrepancies when comparing Allendale School test results and results from this report for interpretation.

   According to the CDC, the method detection limits ranging from 0.01-0.04 ppb (whole weight, g/g) are typical for most methods using about 1 mL of sample. The Allendale School serum collection will result in analyses of 2 mL samples. In general, the CDC's PCB congener specific detection limits for these samples should be approximately half or .005-0.020 ppb (whole weight).

2. **Comment:**
   Proposed Interpretation- Need to use correct language for conveying interpretation of results to parents, to give results some meaning.

   Response:
   MDPH will be working closely with the CDC to interpret the findings. Comparisons will be made to the information from the Third National Report on Human Exposure to Environmental Chemicals (NHANES, July 2005) and other literature sources to properly convey this information to the participant in a letter clearly informing them of where their levels fall (if detected) in comparison with others of the same age and gender.

3. **Comment:**
   Additional Articles for interpreting results:

- Relationship of Lead, Mercury, Mirax, Dichlorodiphenyldichloroethylene, Hexachlorobenzene, and Polychlorinated Biphenyls to timing of Menarche Among Akwesasne Mohawk Girls. Denham, M et al., Pediatrics 2005;115;e127-e134.
- Organochlorines, Lead, and Mercury in Akwesasne Mohawk Youth. Schell, L. et al. Environmental Health Perspectives Vol. 111 Num 7 June 2003, 954 – 961.

Response:
The literature on PCB's is voluminous; we provided only a sample of some of the recent publications. Thank you for providing these references with regard to blood concentrations of youth ages 10-17 years old, we will add them to our background information.

Comments from HMPRT Member 2:

4. **Comment:**
Project Summary, Paragraph 2: I think it is important to remind stakeholders that the newer Building 71 OPCA is lined and that the Hill 78 OPCA, which was pre-existing, is not lined. Although, Hill 78 now only receives PCB waste <50ppm, it did historically receive PCB waste at significantly higher concentrations. It also contains other hazardous wastes that have not been as well quantified or monitored.

Response:
This information has been added to the project summary Introduction/Background paragraph 2 and has been communicated at numerous public meetings. While this information regarding Hill 78 being unlined is accurate, it is important to note that the gradient is toward the River not toward the School.

5. **Comment:**
Consent Forms: I think it's important to share with both parents of children and adults the following. Maybe the best format to do this in would be a **Frequently Asked Questions** format.

a) That you are doing congener specific testing and that you will be looking for congener patterns that may be different from patterns CDC typically observes based on general dietary exposure in the United States.

The Allendale community has been very sensitized to this issue and will be reassured that you are aware that patterns secondary to non-dietary exposures may differ and that they may also be different from the original aroclor mixtures used at the site.

b) That each participant will be evaluated on a case-to-case basis, and that MDPH/CEH will work closely with the CDC to interpret any findings, particularly as they relate to child participants.

c) That MDPH/CEH in collaboration with the CDC will review the test results and decide whether individual or group findings need further follow-up investigation.

d) That a copy of the blood tests results, summary of the questionnaire, and the interpretation will be provided to the participant (or parent of the participant if the participant is a minor) and ONLY them.

If they want to share this information with their individual health care providers, it will be completely up to them. Other parties including but not limited to insurers, employers, school administration, city officials, will NOT receive any information that could be linked to individual participants.

The blood tests results will not be included in individual patients' medical charts unless the participant specifically chooses to share results with their health care provider and specifically requests that a copy be included in their records.

It will also be important for participants and health care providers to have MDPH contact information should they have additional questions or concerns.

Response:
(a) The letter from the MDPH, which went home with students and staff of the Allendale School, informed the Allendale School Community that we are conducting congener specific analysis. We will continue to stress this in all our communication initiatives. (b and c) Language contained in the letter to the Allendale School Community and the consent form express the use of the questionnaire to collect information and conveys the collaboration of the MDPH and the CDC regarding the interpretation of individual results as they relate to children**.** (d and e) The consent form states that the information provided and the blood test results will be treated as confidential information and will not be published or shared with anyone else in a manner that could readily be associated with the individual. (f) We have already had numerous contact with individuals requesting testing and expressing questions/concerns relating to PCBs and the Allendale School Community. Our contact information will also be included with any correspondence including notification of test results.

A frequently asked questions document has also been drafted to communicate these comments to the Allendale School Community.

6. **Comment:**
The participant questionnaire was not included in my packet, and I think it is important for us to review. The Anniston study mentioned that the accuracy of the correlation coefficient between blood PCB concentrations and length of residency will depend on how questions about residency are asked. Many families will move, but their moves are still within a ½ to 1-mile radius of the OPCAs and other PCB contaminated sites.

Response:
It is standard policy to not release a questionnaire before it is administered to the participants. The questions relating to residency on the questionnaire address the possibility of having lived at several previous addresses within a ½ to 1-mile radius of a contaminated site as well as address the possibility of living near other PCB contaminated sites. The questions ask for:

- Current address and length of residency.

- Previous address and length of residency. This question includes space for four previous addresses, when they lived there, and total number of years.
- The questionnaire also includes space for information regarding a child's time spent at additional (current) addresses, a child who may spend a significant amount of time at the residence of a family member or other parent/guardian. The question asks for:
- Additional current addresses (e.g. split residency) or an address where the child spends a significant amount of time.
- % time at each address.
- Length of time he/she has lived or visited there.

7. **Comment:**
   Will you be doing GIS mapping of the PCB blood results that includes prior residencies within 1 mile of OPCA and other contaminated sites?

   Response:
   Individual test results will be analyzed on a case by case basis. The purpose of the questionnaire is to supply supplementary (exposure) information for the individual and provide necessary information to interpret any findings. MDPH/CEH in collaboration with CDC will decide whether individual or group findings need further follow-up investigation based on review of all of the information. This includes looking closely at individual addresses if warranted by the findings of the PCB serum testing, GIS mapping is available if needed.

8. **Comment:**
   Also, if there are "detects" in the PCB blood testing, you may also want to do GIS mapping of participants' maternal residencies. Maternal proximity to the sites may be linked to participants' potential exposures while in utero or breastfeeding.

   Response:
   In situations where the mother is also being tested, we are gathering additional information to answer this type of question if detects are found. If warranted further investigation can be conducted to obtain any information that was not provided by the participant on the questionnaire.
   - We are asking for residence history on both the parent/staff questionnaire and the student questionnaire.
   - There are questions regarding breast feeding on both questionnaires:
     - Parent/Staff- If they have ever breastfed, how many children and how long each child was breastfed.
     - Student- If they were breastfed. If they have older siblings who have also been breast fed, birth order, and how long each sibling was breastfed.
   - We have added a question that specifically asks mother's address at time of child's birth to clarify the address. This will provide the exact address if information is left out of either the mother's or child's residence history.
   - We are also asking for parent/student information, which will match family members to one another in order adequately interpret answers to these questions that directly affect both participants.

9. **Comment:**

Background Research: Thank you for sharing these papers with us. Rich Rosenfeld has mentioned some additional papers that may be helpful in the interpretation of PCB blood testing as it relates to children. In addition, I would like to see the *ATSDR's Health Consultation titled Evaluation of soil, blood, and air data from Anniston, Alabama, Calhoun County, Alabama* included because it specifically discusses potential links with airborne PCBs. The executive summary concludes that exposure to PCBs in the air presents an indeterminate public health hazard, and recommends additional investigation to a. identify persons living near air monitors at which elevated air PCB levels have been detected and b. define the limits of the area with elevated air levels for PCBs. The health consultation can be found by going to: www.atsdr.cdc.gov/HAC/PHA/annpc/ann_p1.html. Also, do you know if there have been any follow-up studies in Anniston?

Response:
The literature on PCB's is voluminous; we provided only a sample of some of the recent publications. Thank you for providing these references, we will add them to our background information.

Comments from HMPRT Member 3:

10. **Comment:**
The protocol has been carefully thought through and addresses the key methodologies and interpretative issues that often arise in studies of this type. The strengths of the protocol include the following.

- The timing of the indoor environmental testing during the warmer months when the site will be more active makes good sense.
- The serum samples will be tested for 38 PCB congeners at the CDC using the latest equipment, methods, and quality control procedures.
- A great deal of thought has been given to selecting comparison survey data that will provide a reasonable set of background levels to which the Allendale School results can be compared.
- Background levels will be ascertained separately for children and adults.
- The epidemiologic questionnaire is very comprehensive and will permit the investigators to assess behaviors that are likely to create opportunities for exposures to environmental PCB contamination.
- The Berkshire Medical Center (BMC), which has participated in previous PCB studies in the area, will continue to provide standardized phlebotomy services for the proposed study.
- The informed consent form has been reviewed and approved by the MSDPH Internal Review Board and the Department's Office of General Council.

In summary, the protocol provides scientifically sound methods for collecting and testing serum samples from children and adults for interpreting study results in relation to normal background levels of PCBs.

Response:
Noted

Comments from HMPRT Member 4:

11. **Comment:**
Are the General Electric PCB congeners within the mix of those in the CDC testing? I assume they all are, so that a fingerprint of subtyping can be accomplished.

Response:
The congeners that we are testing for and the congeners that the CDC has included in NHANES III and IV were chosen on the basis that proven methods for testing are established, that there is exposure data for the population for comparison, and that they are congeners most commonly found in human serum when testing is done. These congeners tend to be the more environmental persistent congeners; the more volatile congeners would be less likely to be found in serum because of their short half life. Aroclors 1260 and 1254 are the PCB mixtures that were thought to be most readily used at the GE site. The 38 congeners that CDC is testing for are included in the composition of Aroclor mixtures 1260 and 1254 listed by the EPA.

12. **Comment:**
In the consent for both the adults and the children, there's a relative paucity of language about:

"An acknowledgement of their understanding that the meaning of elevated PCBs in children's blood is not clear and cannot necessarily be interpreted clinically and that they consent to testing knowing that they cannot be effectively counseled about how to interpret the results. Elevated PCBs in a child's blood cannot necessarily be related to future risks of disease development in that individual child."

"An acknowledgement that a parent consents for testing of their children's blood even though they realize that there is no effective treatment available for elevated blood PCB levels in children."

Response:
The Allendale School Community has been notified of the limitations of testing and interpretation through public meetings and letters sent home with all students and staff. These outreach efforts emphasized that testing was being offered as a public service to address concerns of parents, students, and Allendale School staff, not as a result of an MDPH recommendation. The published analyses from the Centers for Disease Control and Prevention (CDC) Third National Report on Human Exposure to Environmental Chemicals (NHANES III, July 2005) will be used to interpret serum testing results for the students being tested. Counseling on recommendations for future behavior to reduce the potential for exposure to PCBs will be provided for those with elevated PCB levels. We have inserted language into paragraph 1 of the consent form to address the fact that there is no medical treatment to reduce current PCB levels and that counseling on behaviors to reduce the risk of future exposure will be provided. Information is contained in the Frequently Asked Questions (FAQs) of the ATSDR toxicology profile for PCBs and we have also drafted an FAQ sheet specific to the Allendale School PCB testing.

13. **Comment:**

I did not see any agreement in the consent or the material about the testing that contracts for future monitoring of the children should they have elevated blood PCB levels. (or it's certainly possible I overlooked it) And yet a parent (and pediatrician) would reasonably want to know how often the child's blood PCB level should be drawn periodically, for what duration of time, and what other ancillary monitoring by laboratory assessments (thyroid tests? blood counts? hormonal levels?) should be monitored during subsequent well child care. Would the DPH be expecting to serially test the cohort of children who are found to have elevated PCB levels? If so, at what frequency and over what span of time? If not, the parents and physicians need to know in advance the limits of the contracting, I think.

Response:

If we see any unusual findings follow-up will occur as appropriate as well as counseling to avoid any future exposure. We do not expect increased levels in children this young, however if increased levels of PCBs are found they will be examined on a case by case basis. PCBs have an approximate 1-10 year half life depending on the congener so simply offering follow up testing would not be prudent in terms of public health. We are offering serum testing only and do not expect that ancillary testing would be needed for exposure information; clinical effects are not expected at these levels. We will encourage participants to share the results with their physicians if they wish to do so. The limits of testing Allendale School Community has been explained during public meetings and letters distributed to all students and staff.

APPENDIX C: CONSENT FORMS

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
ALLENDALE SCHOOL PCB SERUM TESTING

PARENT/GUARDIAN CONSENT FORM

I understand that the Massachusetts Department of Public Health (MDPH) is offering PCB serum testing to the administration, faculty, and students of Allendale School as a public service. I understand that if my child is found to have elevated serum PCBs that there is no medical treatment to reduce his/her current PCB levels and I will be counseled on behaviors to reduce his/her risk of future exposure. I have requested to have my child participate in this effort.

A blood sample will be taken from my child to determine the level of PCBs in his/her blood. The blood will be taken from a vein in my child's arm and will require the use of a hypodermic needle and vacutainer. Approximately 20 ml of blood will be drawn. This procedure usually involves little pain or discomfort, but occasionally some discomfort may occur after the blood sample is obtained. Other risks, while unlikely, will be explained by the staff from Berkshire Medical Center who will be taking the blood sample. My child's blood sample will only be tested for PCBs. The blood sample will be destroyed after the analysis and quality control measures are completed.

I agree to participate in a short interview (approximately 15 minutes) that will be conducted by MDPH staff in order to collect important information that may be associated with individual PCB exposure and that may help with the interpretation of results.

I understand that staff from MDPH and Berkshire Medical Center who conduct this effort will use the information that I provide and the results of my child's tests only for the purpose of evaluating my PCB exposure. The information I provide and the blood test results will be treated as confidential information and will not be published or shared with anyone else in a manner that could readily be associated with me and my child.

I understand that I will be notified of the result of my child's PCB blood test after all laboratory testing and quality control measures have been completed. This is to ensure the scientific integrity of the final result of my child's blood test.

I agree to being re-contacted for follow-up questions at a later date. I also understand that I am not under any obligation to have my child participate in this blood testing and that I can end my child's participation at any time. I have read and understand the above statement, and I hereby agree to have my child participate in this blood test and interview.

Name of Child _____

Name of Parent/Guardian: _____ **Date:** _____

Signature of Parent/Guardian _____

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
ALLENDALE SCHOOL PCB SERUM TESTING

ADULT CONSENT FORM

I understand that the Massachusetts Department of Public Health (MDPH) is offering PCB serum testing to the administration, faculty, and students of Allendale School as a public service. I understand that if I have elevated serum PCBs that there is no medical treatment to reduce my current PCB levels and that I will be counseled on behaviors to reduce my risk of future exposure. I have requested to participate in this effort.

A blood sample will be taken from me to determine the level of PCBs in the blood. The blood will be taken from a vein in my arm and will require the use of a hypodermic needle and vacutainer. Approximately 20 ml of blood will be drawn. This procedure usually involves little pain or discomfort, but occasionally some discomfort may occur after the blood sample is obtained. Other risks, while unlikely, will be explained by the staff from Berkshire Medical Center who will be taking the blood sample. My blood sample will only be tested for PCBs. The blood sample will be destroyed after the analysis and quality control measures are completed.

I agree to participate in a short interview (approximately 15 minutes) that will be conducted by MDPH staff in order to collect important information that may be associated with individual PCB exposure and that may help with the interpretation of results.

I understand that staff from MDPH and Berkshire Medical Center who conduct this effort will use the information that I provide and the results of my tests only for the purpose of evaluating my PCB exposure. The information I provide and the blood test results will be treated as confidential information and will not be published or shared with anyone else in a manner that could readily be associated with me.

I understand that I will be notified of the result of my PCB blood test after all laboratory testing and quality control measures have been completed. This is to ensure the scientific integrity of the final result of my blood test.

I agree to being re-contacted for follow-up questions at a later date. I also understand that I am not under any obligation to participate in this blood testing and that I can end my participation at any time. I have read and understand the above statement, and I hereby agree to participate in this blood test and interview.

Name: _____ **Date:** _____

Signature: _____

APPENDIX D: NIST STANDARD AND ANALYSIS RESULTS

The results included in this report are based on analyses performed by three different laboratories using different analytical techniques to measure PCBs (Aroclor or congener-specific). As part of the QA/QC protocol developed prior to the start of sampling, SWRI and SUNY agreed to analyze a sample from the National Institute of Standards and Technology (NIST) that contained known quantities of certain congeners. The purpose of this step was to determine the comparability of the SWRI and SUNY analyses and how closely their results matched with the known quantities of congeners in the NIST sample. NIST does not produce samples for Aroclor analysis.

The Table shows the results of the NIST sample analyses. The NIST standard reference material had 30 congeners at certified levels ranging from 0.00414 to 0.0402 mg/kg. SWRI detected 24 of the 30 congeners with concentrations with an average recovery rate of 95%. The recovery rate is the concentration of the congeners detected by the laboratory divided by the known concentration multiplied by 100. SUNY detected all of the 29 congeners that were included in its analysis, with an average recovery rate of 43 %. All of the SUNY concentrations for the congeners reported in the NIST standard were less than the certified concentrations.

Congener #	NIST standard (mg/kg)	SWRI (mg/kg)	SUNY (mg/kg)
18	0.0128 ± 0.001	0.018	0.0029
28	0.0134 ± 0.0005	0.011	0.0057
31	0.014 ± 0.0005	0.015	0.0041
44	0.0181 ± 0.0019	ND (0.0094)	0.0066
52	0.0218 ± 0.0019	0.015 [+69]*	0.0091
56	0.00442 ± 0.00028	ND (0.0094)	0.0010
70	0.0131 ± 0.0012	0.018	0.0075
74	0.00522 ± 0.00051	ND (0.0094)	0.0018
87	0.0166 ± 0.0008	ND (0.0094) [+115]*	0.0068
92	0.00548 ± 0.00072	0.0047	0.0013
95	0.0227 ± 0.0026	0.017 [+93]*	0.0099
99	0.0116 ± 0.0004	0.0077	0.0053
101	0.0298 ± 0.0023	0.025	0.0145 [+90]*
105	0.0132 ± 0.0014	0.013	0.0050
107	0.00414 ± 0.00047	ND (0.0094)	Not reported**

Congener #	NIST standard (mg/kg)	SWRI (mg/kg)	SUNY (mg/kg)
110	0.0281 ± 0.0037	0.024	0.0129
118	0.0263 ± 0.0017	0.026	0.0135
138+163	0.0348 ± 0.0033	0.0321 [+164]	0.0163 [+164]
146	0.00489 ± 0.00038	0.0042	0.00268
149	0.0244 ± 0.0019	0.02	0.0102 [+123]
151	0.00692 ± 0.00064	0.0062	0.0031
153+132	0.0402 ± 0.0018	0.023	0.0122
158	0.00450 ± 0.00043	ND (0.0094)	0.0017
170	0.0088 ± 0.0010	0.012	0.003
174	0.00883 ± 0.00047	0.0073	0.0063
180	0.0184 ± 0.0032	0.014	0.0072
183	0.00527 ± 0.00039	0.008	0.0015
187	0.0113 ± 0.0014	0.012	0.0069
206	0.00381 ± 0.00013	0.0031	0.00285

* Combined analytical result with congener number in brackets

** Congener 107 was not reported in results from SUNY lab

*** Congeners 138 and 163 were reported as combined in SUNY lab report. NIST standard values for both congeners were added in line for combined congeners.

APPENDIX E: EXPOSURE CALCULATIONS

In order to further assess contaminants, such as PCBs, and possible related health concerns, calculations are made to estimate the amount of a contaminant people may come into contact with each day (i.e., exposure dose). These calculations account for several factors that are specific to the location and the medium being analyzed. The maximum concentration is the highest amount of the contaminant found during sampling for each medium. This is a conservative assumption since it is unlikely that an individual would be continuously exposed to the highest concentration. Exposure frequency is the rate of exposure within a given time period. For Allendale Elementary School, it is estimated that students and teachers are inside the school for 180 days/year and could be exposed each day. Exposure duration is the length of time of a continuous exposure. For students and teachers, this is estimated to be 6 and 30 years, respectively. The averaging time is the number of days in which an exposure is averaged. For cancer concerns, the default value is the number of days in a 70-year lifespan. Once the exposure dose is calculated, it is multiplied by the cancer slope factor to produce a theoretical cancer risk. The cancer slope factor for PCBs is 2 $mg/kg/day^{-1}$ (USEPA 1997a). Dermal exposures have several factors that are specific to them alone. The dermal absorption fraction is the percent of the contaminant that is absorbed through the skin. For PCBs, it is 0.14 (USEPA 2004). Event frequency is the estimated number of times that an individual will have contact with the maximum concentration of the contaminant. It is estimated that students and teachers could come into contact with two areas containing PCBs each day. The skin surface area is the amount of skin that is exposed and may come into contact with the contaminant. For students and adults, it is estimated to be 1433 cm^2 and 2479 cm^2, respectively, corresponding to the amount of skin on hands, forearms, and face (USEPA 2004). Air exposures include inhalation rates, which are the volume of air that children and adults breathe each day. For children, it is 10 cubic meters per day (m^3/day). For adults, it is 15.3 m^3/day (USEPA 1997b). Carpet and vacuum dust exposures include soil ingestion rates, which for children is 200 milligrams per day (mg/day) and for adults is 100 mg/day (ATSDR 2005). Soil ingestion rates were used because dust ingestion rates are not available.

1. SURFACE WIPES

Child

Maximum Concentration:	0.00000294 mg/cm^2-event
Dermal Absorption fraction for PCBs:	0.14
Exposure Frequency:	180 days/year
Exposure Duration:	6 years
Event Frequency:	2 events/day (1 inside and outside classroom)
Skin Surface Area:	1433 cm^2
Body Weight:	35 kg
Averaging Time:	25,550 days
Cancer Slope Factor:	2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * DermalAbsorptionFraction * ExposureFrequency * ExposureDuration * EventFrequency * SkinSurfaceArea}{BodyWeight * AveragingTime}$$

Exposure Dose = 1.4 x 10^{-6} mg/kg/day

Theoretical Cancer Risk = Exposure Dose * Cancer Slope Factor

Theoretical Cancer Risk = 3 x 10^{-6}

Adult

Maximum Concentration:	0.00000294 mg/cm^2-event
Dermal Absorption fraction for PCBs:	0.14
Exposure Frequency:	180 days/year
Exposure Duration:	30 years
Event Frequency:	2 events/day (1 inside and outside classroom)
Skin Surface Area:	2479 cm^2
Body Weight:	70 kg
Averaging Time:	25,550 days

Cancer Slope Factor: 2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * DermalAbsorptionFraction * ExposureFrequency * ExposureDuration * EventFrequency * SkinSurfaceArea}{BodyWeight * AveragingTime}$$

Exposure Dose = 6.2 x 10^{-6} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 1 x 10^{-5}

2. AIR

Child

Maximum Concentration of PCBs: 0.0000117 mg/m^3
Inhalation Rate: 10 m^3/day
Exposure Frequency: 180 days/year
Exposure Duration: 6 years
Body Weight: 35 kg
Averaging Time: 25,550 days
Cancer Slope Factor: 2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * InhalationRate * ExposureFrequency * ExposureDuration}{BodyWeight * AveragingTime}$$

Exposure Dose = 1.4 x 10^{-7} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 3 x 10^{-7}

Adult

Maximum Concentration of PCBs: 0.0000117 mg/m^3

Inhalation Rate:	15.3 m^3/day
Exposure Frequency:	180 days/year
Exposure Duration:	30 years
Body Weight:	70 kg
Averaging Time:	25,550 days
Cancer Slope Factor:	2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * InhalationRate * ExposureFrequency * ExposureDuration}{BodyWeight * AveragingTime}$$

Exposure Dose = 5.4 x 10^{-7} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 1 x 10^{-6}

3. CARPET SURFACE DUST

Child

Maximum Concentration of PCBs:	0.526 mg/kg
Soil Ingestion:	200 mg/day
Conversion Factor:	0.000001 kg/mg
Exposure Frequency:	180 days/year
Exposure Duration:	6 years
Body Weight: 35 kg	
Averaging Time:	25,550 days
Cancer Slope Factor:	2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * IngestionRate * ExposureFrequency * ExposureDuration * ConversionFactor}{BodyWeight * AveragingTime}$$

Exposure Dose = 1.3 x 10^{-7} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 2×10^{-7}

Adult

Maximum Concentration of PCBs:		0.526 mg/kg
Soil Ingestion:		100 mg/day
Conversion Factor:		0.000001 kg/mg
Exposure Frequency:		180 days/year
Exposure Duration:		30 years
Body Weight:	70 kg	
Averaging Time:		25,550 days
Cancer Slope Factor:		2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * IngestionRate * ExposureFrequency * ExposureDuration * ConversionFactor}{BodyWeight * AveragingTime}$$

Exposure Dose = 1.6×10^{-7} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 3×10^{-7}

4. VACUUM BAGS

Child

Maximum Concentration of PCBs:	1.29 mg/kg
Soil Ingestion:	200 mg/day
Conversion Factor:	0.000001 kg/mg

Exposure Frequency:	180 days/year
Exposure Duration:	6 years
Body Weight:	35 kg
Averaging Time:	25,550 days
Cancer Slope Factor:	2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * IngestionRate * ExposureFrequency * ExposureDuration * ConversionFactor}{BodyWeight * AveragingTime}$$

Exposure Dose = 3.1 x 10^{-7} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 6 x 10^{-7}

Adult

Maximum Concentration of PCBs:	1.29 mg/kg
Soil Ingestion:	100 mg/day
Conversion Factor:	0.000001 kg/mg
Exposure Frequency:	180 days/year
Exposure Duration:	30 years
Body Weight:	70 kg
Averaging Time:	25,550 days
Cancer Slope Factor:	2 mg/kg/day^{-1}

$$ExposureDose = \frac{Concentration * IngestionRate * ExposureFrequency * ExposureDuration * ConversionFactor}{BodyWeight * AveragingTime}$$

Exposure Dose = 3.9 x 10^{-7} mg/kg/day

Theoretical Cancer Risk = Exposure Dose x Cancer Slope Factor

Theoretical Cancer Risk = 8 x 10^{-7}